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ON THE DAGUERREOTYPE.

Inquiries having been very frequent, whether photographic pictures taken from life may not be made of full size, it may be well to state some of the optical difficulties which would present themselves in an attempt of that kind, as much valuable time might otherwise be lost in endeavoring to accomplish what is impracticable.

Let A represent two lens, four inches diameter, used in combination; the focal distance B of the two together, being eight inches, for an object D, six feet distant from the lens. These lens, if they were properly constructed, would be suitable for making a picture with sufficient sharpness of outline, in which the head is one inch long.

Let us now compare this arrangement with one suitable for taking them of full size.

As from the result of experiment, the time required for taking a picture is inversely as the quantity of light condensed to form the image, it follows, that in order to produce pictures in the same time, with lens of different foci, their diameters should bear the same proportion to their focal distance; and also it being found that lens of very great aperture in proportion to their focal distance will not make an image sufficiently distinct but at very short distances from their axis, the above proportion of eight inches focus to one inch length of head must be pre-

served; therefore, in order to take one of full size, (say nine inches long for the head) in the same time, the focal distance should be six feet, and the diameters of the lens three feet. This is supposing that the glass was no thicker, and that the number of lens was not increased; but this would not be the case; for let us suppose A to be two lens of 3 feet diameter, the focus B 6 feet distant, and the object D 54 feet distant: this would make the image at B the same size with the small lens. But as the object in order to make an image of full size, must be only 6 feet off, as at C, instead of 54, the rays from the object will fall very divergingly on the glass—so much so that it would require two more lens to cause the light to fall as nearly parallel on the first pair of lens as it did in the case of the small glasses. Now the loss of light at the surfaces of two additional lens, and in passing through four lens each $2\frac{1}{2}$ inches thick in the centre, would probably be one half; and if we should attempt to compensate for the loss of light by enlarging the diameter of the glasses, we would so rapidly increase their thickness and errors from figure as to prevent its being of any advantage: besides, if the diameters of the large lens may be increased, that of the small ones may also be; so that it would take at least twice as long to make a picture of any quality of full size as it would of $\frac{1}{9}$ the length. What the quality of the picture would be we shall presently perceive.

In consequence of some parts of the head of the person being necessarily more distant than others from the lens, they cannot all be in focus at once; and we shall find that the distance of the sitter from the lens will be to the diameter of the lens, as the distance that any part of the head may be from the focus, is to the diameter of the circle of aberrations for that part. Thus, if E represent the position of any point of the head two inches distant from the focus D, a section at E of the cone of light will present a disc of $\frac{1}{9}$ of an inch in diameter; for, as 6 feet is to 4 inches, so is 2 inches to $\frac{1}{9}$ of an inch; and any point of the head in the picture corresponding to any part of the person two inches out of focus, will be formed of rays coming from a disc of $\frac{1}{9}$ of an inch in diameter; and this will be the aberration for the small lens. With the large lens the statement will be thus: as 6 feet

is to 3 feet, so is 2 inches to 1 inch; so that, while with the small lens the aberrations of any part 2 inches out of focus is $\frac{1}{81}$ of the length of the head, it will be in the case of the large lens $\frac{1}{9}$ of the length of the head. The aberrations proportional to the sizes of the head in superficial measure (that in which it is presented to the eye) in the two cases would be to each other as 1 to 81; a vast difference in favor of the small pictures.

If we should now take a medium course, and lengthen the time, and use a less aperture, in order to obtain more distinctness, the following proportions may answer: Lens six inches diameter, with both foci three feet distant. The focal distance is shortened in this case, in consequence of the small aperture rendering objects distinct at proportional greater distance from the axis; the focal distance being three times as great in proportion to the aperture as in the former case, it will take nine times (which is its square) as long to form the picture, and the aberrations will also be nine times as great; for 36 inches is to 6 inches as 2 inches is to $\frac{1}{3}$ of an inch. This would probably be the best arrangement to take a picture of full size *directly* from life; as on the one hand we have an almost insurmountable mechanical difficulty in making the lens, and an indistinctness which would destroy the features; and if we were to lessen the aperture still more, to obtain an increased degree of distinctness, the operation would be so prolonged that no person could sit throughout the time necessary for it. From the foregoing considerations it will be easy to understand that intermediate sizes will be more difficult to make, the nearer they approach the full size. There are many other objections to making large pictures directly from life; but as the above is the most important one, I shall not notice them.

Considering the length of time required, and the indistinctness of the picture when finished, it would appear that the best way to obtain large pictures would be, to take a small picture in the first instance, and copy it on a large scale with a lens of small aperture, in which the aberrations would be very small, especially as the picture to be copied would be on a plain surface, and not like the real object, different parts at different distances. There would also be this gained: that if the picture were taken

with a lens in the first instance, it would not require a plane mirror to be used; for although the original picture would have the sides of the face reversed, the copy would be right.

In taking daguerreotype pictures, it appears to be necessary to have the *difference* in the intensities of light thrown on different parts of an object much less than would be pleasing to the eye, as there is a much greater difference in the light and shade of the picture than is seen in the object itself—that is, if the action of the light be just continued long enough to produce the best effect. For instance, if the likeness of a person be taken in a room with the sun-light falling on him through a window, the parts in shade will probably be invisible in the picture, although easily seen when looking at the person. But if the action of the light has been continued too long, the reverse of this appears to take place, and the difference in light and shade seems to be *less* than it should be to correspond with the appearance of the object, and the mercury does not seem to attach itself in exact proportion to the quantity of light, but in an increasing ratio at the commencement of the action of the light, and in a decreasing one in a more advanced stage, until finally the quantity becomes less as the light is still farther increased.

In consequence of this irregular action of the light, the shading of these pictures is seldom true to nature; and wherever the correct representation of a part depends on correct light and shade, and not on mere outline, the best effect is very difficult to arrive at.

Although there appears to be no production of colors on a daguerreotype picture necessarily corresponding with those of the object copied, still there sometimes will be seen an occasional approximation to some one of the colors of an object which may have an agreeable effect. Thus, if the picture of an individual be taken with blue glass interposed between him and the source of light, the face will never or very rarely become as white as a collar or other white part of the dress, (even if more time be allowed) but will have a decidedly more flesh-like appearance. Is not the action of the blue light in the daguerreotype a confirmation of the truth of that theory of light which assumes that there are but three primary colors—red, yellow,

and blue—and that each of the three colors may be found at any part of the spectrum, and that the different parts only appear of the particular color, because that color is in excess at that part? Now, the action of the blue light in the daguerreotype exactly corresponds with this theory, the impression being strongest where the blue is the most intense, and diminishing in the other parts of the spectrum in about the same manner as the blue light is said to do in this theory. Are not the blue rays of light and those which affect the iodide of silver identical?

In an article published in the 3d number, vol. ii, of the American Repertory, and taken from the Lond. and Edin. Phil. Mag. it is stated as a defect in the instrument, that the reflecting camera will not give the parts which are at all distant from the centre but in a very confused manner. This appears to be a mistake; for if a lens has an aperture of half its focal distance, (which is necessary in taking a picture from life) its indistinctness at a proportionate distance is somewhat greater than that of the reflector, when both are used with proper diaphragms in front; consequently, a lens of the same focal distance and aperture as a reflector (if the proportions are those stated) cannot make a good picture of a larger size than can be produced with the reflector. A picture of 4 by 5 in. may be very easily taken by the reflector; but if much larger than that, it had better be copied as before mentioned. The manner of illuminating the person, described in the same article, appears to be a description of the method originally used by me.

In justice to myself, I would take this opportunity of correcting a statement I made in a former communication, in which I said that a lens of $3\frac{2}{3}$ inches was equal to a reflector of 7 inches diameter—both being of the same focal distance. That experiment was made with a reflector which had lost much of its power of reflecting the rays which are the most effective in the daguerreotype. I have since tried the experiment with a newly polished reflector, and found it to be equal to a lens of the same aperture. Those reflectors which are constructed of glass, silvered, retain their power of reflecting; but the images are not quite so clear, from the light having to pass twice through the glass.

A. S. WOLCOTT.

[For the American Repertory.]

ON THE STEAM-ENGINE.

(CONTINUED.)

Leaving for a time the works of the learned theoretical writers named at the head of our article, we proceed to examine the unsophisticated practical account which the steam-engine gives of its effects, powers and doings in the diagram described by the engine of the Great Western, (page 274) detailed for elucidation in the following table; where, in column 1st will be found the quantities of steam expended, taken from the scale with sufficient accuracy for the general view here contemplated; in column 2d, the proportional expansion of those quantities; in 3d, the effective pressure of the initial steam, unbalanced by the steam reäcting in the vacuum; in 4th, the actual average steam pressure during the whole stroke; in 5th, the density of the steam at the termination, when it is allowed to escape to the condenser as valueless; in 6th, the revolutions of paddle-wheels; in 7th, the squares of those revolutions; in 8th, proportional numbers obtained for comparison with the squares of revolutions—thus, as 11·19, the average steam expended at $\frac{4}{12}$ stroke, is to 13·84, the average steam expended at $\frac{7}{12}$ stroke, so is 182·2, the square of 13·5 revolutions, to 225·9, which in this particular instance differs but a fraction from the square of 15 revolutions by calculation, rendering it probable that the other results in this column, from assumed data, are equally conformable with the law relating to velocity as laid down by Tredgold and others:—in 9th, are the quantities of steam expended; in 10th, the power gained by the expansion of the steam in the 9th; in 11th, the total joint effect of the expenditure of steam in the 9th, and its expansion in the 10th.

1	2	3	4	5	6	7	8	9	10	11
PARTS OF STROKE.		Unbalan'd pressure of initial Steam.	Average unbalan'd Steam pressure.	Density of steam at terminat'n rejected as valueless.	Revolutions of paddle wheels.	Squares of revolut'ns of paddles.	Proportio. numbers from av. steam pressures.	Quantity of steam expended.	Clear gain derived from expansion of steam.	Joint effect produced by expen. and expans.
Steam admitted and expended.	Steam expanded.									
$\frac{4}{12}$	$\frac{8}{12}$	16.lbs.	11.19	5.33	13.5	182.2	182.2	4.0	4.39	182
$\frac{11}{24}$	$\frac{13}{24}$	15.75	12.83	7.23	14.3	204.4	209.5	5.5	4.08	204
$\frac{7}{12}$	$\frac{5}{12}$	15.50	13.84	8.99	15.0	225.	225.9	7.0	4.17	225
$\frac{17}{24}$	$\frac{7}{24}$	15.25	14.35	10.82	15.18	230.4	234.2	8.5	2.90	230
$\frac{10}{12}$	$\frac{2}{12}$	15.00	14.73	12.60	15.86	235.9	239.3	10.0	2.0	235
$\frac{45}{48}$	$\frac{3}{48}$	14.75	14.69	13.27	15.45	239.1	239.1	11.25	0.75	239

We ought to consider it as a very fortunate circumstance that the steam-engine has become its own commentator: we thus obtain certain facts, unalloyed by prejudices or conceits—an occurrence as rare as valuable; and we are shown at a glance that the mere direct force of steam, whether high or low, is like brute force—unintellectual, unprofitable, and even discreditable, wherever circumstances admit of its employment expansively. In fact, it seems hardly possible that the wit of man, whether by precept or example, can exhibit either *better* or *worse* modes of employing steam than are shown in this diagram of the actual performance of one of the *best* British engines, but one that is yet, as we shall see, susceptible of very great improvements. Thus, in column 5th, the density of steam at the end of the stroke, when it is thrown away as valueless, is in exact inverse proportion to the useful effect obtained from the steam; for, when the greatest effect has been obtained in the diagram, the density of the residual steam is only 5.33 lbs; and when the least useful effect has been obtained, the residual density is 13.27 lbs.; and this denser steam is as recklessly thrown away as was the weaker steam: even the policy of this is now unquestioned; but it will become very questionable at a future period of our investigation. Again: as we see by the diagram, in the expenditure of steam but little expanded, the quantity being 10, the effect produced is 235, while the expenditure of steam expanded to thrice its volume being only 4, the effect produced is 182; but, 4 : 10 : : 182 : 455. Thus almost double proportional effect is obtained by the greater expansion of this smaller quantity of steam combined with the better vacuum in the cylinder. It is apparent that the joint gain from these two causes would have been proportionally greater but for the gain in the first instance of 2.0, by expanding the same steam from $\frac{10}{12}$, and that the effect of all the causes acting in the latter case would have been to that obtained from unexpanded steam in a greater ratio than 2 to 1.

Now, that there should be a greater gain from the use of steam when little is thrown away that is useful, and that there should be a lesser gain when much is thrown away that still remains useful, must be as consonant to fact as to reason; yet we shall

soon see that facts and reason are alike neglected and disregarded, and in the most important constructions, are continually sacrificed to unfounded prejudices or to careless inattention; notwithstanding we are as ostentatiously as haughtily rebuked by a correspondent of this work for stating those facts beyond his observation, but which are most important to be known.

In the diagram we see another fact established by the steam engine, very essential to be clearly understood, and to be determined beyond dispute, viz. the squares of the revolutions of the paddles are as the power expended to produce that velocity. But the all-important, the truly invaluable fact for suffering humanity, that may be derived from and undeniably proved by the diagram, is, that steam of 16 lbs. per inch, expanded to thrice its volume, and therefore of only 11.19 lbs. average absolute density, being on the average of the whole stroke 3.81 lbs. less than atmospheric density, and of only 5.33 lbs. density at the termination of stroke; and for more than half the stroke being of less density than the atmosphere—that this weak steam, scarcely stronger than the steam escaping from a common teakettle, and utterly incapable of exploding—is not only proved as efficient, but from its economical and intellectual application, proportionally twice as efficient as expanded steam of 14.71 lbs. average density, and proportionally much more than twice as efficacious as unexpanded steam of any greater density, whatever.

How erroneous, how mischievous, then, were Mr. Palmer's assumptions! How idle, how dangerous the incessant assertions of such hosts of engineers and inconsiderate writers, that high steam is essentially required for power and economy in condensing engines, when we here see them plainly and flatly contradicted by facts!

This practice, so dangerous, and wasteful as dangerous, has been inculcated and confirmed by the strangest statements imaginable of superficial thinkers. Thus, among a multitude of writers, Prof. Renwick repeatedly asserts that the friction of a Watt's double engine (the engine of the Great Western) is $7\frac{1}{2}$ lbs. the superficial inch. Were this statement founded on reason or on fact, it would have been useless to expect and impos

sible to obtain any advantage from the use of low steam when expanded, which we have seen is fully efficient for every useful purpose in these engines, notwithstanding those assertions, that are, as we shall hereafter find, the greatest hindrances to real improvement and the exercise of reason.

In the first place, it is perfectly absurd to fix on any precise quantity whatever for friction in these engines, because the friction therein ever varies with the dimensions, so that it is never alike in any two engines of different sizes; for in quadrupling the area of the cylinders and the power of the engines, the friction in the cylinders is merely doubled, and vice versâ; the friction in small cylinders becoming enormous when compared with that in larger ones. Thus their fixed theoretical assumptions become absurd, when compared with facts, or reduced from theory to practice.

We have seen it proved by the diagram, that the steam is proportionally as efficient at 11 lbs. elasticity as at 15 lbs. because of the accompanying gain from the better vacuum in the former case. Were we to deduct $7\frac{1}{2}$ from 15 lbs. we have $7\frac{1}{2}$ lbs. efficiency remaining: were we to deduct $7\frac{1}{2}$ lbs. from 11 lbs. we have only $3\frac{1}{2}$ lbs. efficiency remaining. Thus, where a theoretical loss or difference of 4 lbs. per sq. inch would attend the Professor's statement, we find but a small loss in appearance, and none whatever in effect, in this the very material and principal friction in these engines, so perpetually and perniciously miscalculated. Further, when we have seen that steam used, which at the termination of the stroke was of only 5.33 lbs. elasticity, to conceive the friction of the engine was then 7.5 lbs. or 2 lbs. per inch more than the effective force of the steam, which notwithstanding retained its efficiency, requires a credulity the most absurd, however strongly the statement may be vouched for.

The diagram and table also tell another unvarnished tale, without which all reasoning would be useless, all calculation would be visionary and baseless. They prove how effectively and accurately the engines of the Great Western are constructed, by the exact coincidence found between the facts observed and the power derived from the calculated quantities of steam em-

ployed and expanded. These proper and happy results are unattainable except by similar skill, tools, and care, and hence numerous cases are adduced to controvert and unsettle the sound deductions of science and mechanical experience, which, if submitted to rigorous examination, would prove to be founded upon misapprehension or gross mechanical errors, whose existence even must be unsuspected by the inexperienced.

As a portion of the steam in the diagram produces more than double the effect of the larger portion used, it is evident to reason that all the steam might be, and that all ought to be, as well employed; and that we are only fulfilling our duty to society, by pointing out the great advantages that would thence ensue, and as a consequent, the disadvantages of neglecting these costless intellectual benefits, so much overlooked by British marine engine manufacturers, or neglected rather, from the unfortunate opinion every where prevailing, that high steam is essential as incipient steam for expansion, though nothing can be more opposed to true economy than this opinion It is true, the English engineers, dreading the increased danger of using high steam in marine navigation, have preferred safety above all considerations of profit or fame, but like all other engineers, they are still unaware of the extent and value of this fact, that all the advantage of expanding steam may be as fully and cheaply obtained from low steam as from high, and this without the danger that must ever attend the use of the latter.

It will hereafter become apparent, when we have had time to adduce our proofs, that much more advantage, and far greater effect can be obtained from low steam than from high. This subject, then, demands the earnest and immediate attention of all possessing science, patience, capacity or humanity. Now a very different, a very hazardous and fancied improvement of the steam-engine, has been and is pursued in this country, and is so firmly accredited here, that to doubt its general correctness is as bad as *heresy*. We cannot give a fuller and plainer description of the vulgar errors prevailing in relation to it than is contained in the animadversion (page 344) upon our honest and zealous, but we fear, thankless and unprofitable endeavors to be useful to mankind; the strictures alike exhibiting

the difficulty of our position, and the necessity for this or a similar investigation, however unpalatable it may prove.

"I cannot refrain from noticing that your correspondent recommends the expansive mode of using steam, in language for which there is not the least occasion ; indeed, the only inference to be drawn from his tone is, that the economy of expansive steam is neither understood nor acknowledged in this country. Now this is a palpable injustice to the American engineers—there being not one single steam-boat in the whole Union in which steam is otherwise worked than on that principle. In this section of the country in particular, the engineers, proverbial for practical knowledge, have greatly excelled the marine engineers on the other side of the Atlantic, and carried this obvious mode of using steam to almost the highest state of perfection of which the principle is susceptible."

"The extravagant notion of Professor Renwick, or the ignorance of Mr. Palmer, as to the maximum power of steam, surely furnishes no reason to treat the subject in a manner calculated to detract greatly from the praise due to those who by the great practical results which they have achieved, have proved how well they understand it, and how fully they appreciate the value of a principle which has been thus ostentatiously propounded, and most erroneously assumed to be not only unknown, but resisted."

Now your correspondent in reality greatly praises our attempt, though unintentionally, since he allows the notions of Professor Renwick to be extravagant, and of Mr. Palmer to be ignorant ; all which notions at the time we wrote were current, and fairly represented the general opinions and practice of American and English engineers. He should further allow that our analysis of those notions, by the production of facts, has been pretty successful and useful in so short a period ;—that his very solemn and very unostentatious remarks on us should be equally creditable to him, and as convincing to others, requires that his assertions be equally supported by facts.

But although your correspondent, as he informs us, has been digesting this mighty performance since August, his mountain has not brought forth even a mouse, since he offers no one fact

in proof of his assertions. Now he will soon discover that facts are as much needed to substantiate his declarations, as life and intellect to animate the clod from which an engineer is created; for we here undertake to controvert all he has asserted, by facts which he can neither gainsay nor misstate, and neither he nor any one else misunderstand.

It is no question with us, because it is unnecessary, whether the American engineers understand the value of expansive steam or not, as we have already questioned at page 169 their having obtained the benefit thereof, because they have ever used improper and ineffective means to secure it. We have never questioned, that the throttle valve they universally employ in this section of the country, to cut off the steam, would form a very creditable damper to lessen the draught of a chimney; but any person who really understands the matter, must know that such an imperfect and coarse contrivance will only intercept the greater part of the steam in its passage to the cylinder, when it might be most effective—that is, when the piston is traveling nearly with the velocity of the crank-pin; and on the contrary, that this valve, when the steam is much expanded on one side thereof, and remains of great density on the other side, when the piston is traveling one inch, while the crank-pin travels ten, allows the steam to enter fifty times as rapidly as when most effective. This all but "perfection" of your correspondent inflicts other and great injuries on the steam-engine, that we forbear at this time to enumerate.

These mistakes, too hurtful and common to be readily credited at sight, are proved to their full extent by the following *fact:* The engine in one of the Hudson River steamboats has lately been altered in a novel and very ingenious manner, to cut off the steam effectually, instead of ineffectually, as formerly by a throttle valve, like those in general use. The result is, the furnaces and the consumption of fuel have been reduced one-half, the engine has plenty of steam, and works entirely to the satisfaction of Mr. Stevens, the talented proprietor of the boat—the Columbus.

As a single fact is of more value than innumerable arguments, let us be guided by facts; let us compare one of the proudest

achievements of American engineers with one of the British engines, with whose capacity for improvement we have become acquainted; let this imperfect performance of the British engineers, in which the very great advantage of expanding steam is but little obtained, (page 275) be compared with a vessel in which this "obvious advantage" has been carried "almost to the highest state of perfection," and so greatly "excels the marine engineers on the other side of the Atlantic."

If we collect the necessary facts, and if, shunning all technicality, we compare the two engines by means of the quantity of fuel consumed, and the work performed by each, we shall avoid giving reasonable cause for offence to the engineers on either side of the Atlantic. There are however many difficulties to surmount, before we can arrive at a tolerably fair conclusion. There are so many varied and real advantages in favor of the North America, one of the finest boats on our waters, built for speed alone: in her form, deemed an exquisite; her narrow beam, great length, slender cutwater, small draft and displacement, steady and undeviating course over the placid waters of the Hudson. All these great advantages can only be generally estimated against the disadvantages of the Great Western—her wider beam, yet nearly similar length; great displacement and unwieldly shape; her lofty hull and cumbrous rigging, opposed to the wind; her undulating, deviating, unsteady course—sinking now into the trough of the sea, now emerging to force her way through the crested wave, often with an immense expenditure of the power of her engines, which when most wanted can only be worked at a lessened speed.

There is yet another burthen on the Great Western, from which the North America is wholly exempt: the unequal effect of her paddles from undue immersion, the general laborious action of which, under these circumstances, is described at page 347, by a writer on Ericsson's Propeller. Their disadvantageous action is greatly increased at the commencement of each voyage, when the paddles are immersed five feet more than they should be, and when the log-book always exhibits a great decrease in the daily rate of passage from this cause.

The Great Western consumes 28 tons bituminous coals per

24 hours; the North America, 10 tons anthracite coals in 10 hours. Anthracite coal being principally carbonaceous matter, like coke, is presumed to be similar in heating power to that material, which constitutes two-thirds of the substance of bituminous coals.

Coke has been reported, by Mr. Apsley Pellat to the British engineers, to possess as great heating property in a glass-house furnace as the coal from which it was derived. Hence it would appear, that bituminous coal possesses only $\frac{2}{3}$ the heating powers of coke;—the latest published estimates we are aware of. But our experience enables us to attribute far greater heating powers to bituminous coals, having many years since observed in a foundery, that a small steam-engine, requiring at times 4 cwt. coals per day, was commonly driven by the flare or gaseous products of a coke oven, nightly filled with 24 cwt. coals, and producing 16 cwt. coke; this would show that 24 cwt. bituminous coals is fully equal to 20 cwt. anthracite. Thus may we assume the heating power of the fuel in each vessel to be very nearly the same; and a trifling difference is of little consequence in our argument.

The speed of the North America is 14.5 miles per hour, loaded; the average speed of the Great Western is 8.5 miles per hour, exclusive of deviations from her course, which must be considerable. The average outward passage of this vessel being 16½ days, the average homeward 13 days 9½ hours, (page 61, of this volume) = 358.5 hours×8.5 miles=3047.4 miles run between New-York and Bristol, which nearly agrees with the distance run in the most favorable voyages.

The comparative fuel required for power, determined by the diagram and statistical writers, being as the squares of the velocities, is as $8.5^2 : 14.5^2$, or as 70.25 : 210.25; very nearly as 1 to 3 for vessels of equal burden, draft of water, and otherwise alike. It follows, then, that as much power is required to propel the North America 14.5 miles per hour as to propel the Great Western 8.5 miles, were the Great Western assumed three times the weight of the North America; but the tonnage of the Great Western when her fuel has been half expended is five times as great as that of the North America when loaded,

exclusive of all the unestimated advantages the latter possesses over the former. Can we then doubt that the fuel is fully twice as efficient in the Great Western as in the North America?

The ascertained speed (as we are informed by the engineer) of the Great Western, light, and in smooth water, is 12 miles per hour. The relative powers of the two vessels, were they alike, would be as 12^2 to 14.5^2, or as 144 : 210.25, or as 1 to 1.48. Hence, were the weight of the Great Western as 1.48, and the North America as 1, the power of the respective engines might be considered alike.

But the weight of the Great Western, light, is nearly four times the weight of the North America; the fuel consumed in the former is therefore much more than twice as effectual as that consumed in the latter. Indeed, were the speed of the Great Western even less than 11 miles per hour, her fuel would be more than twice as effective as the fuel in the North America.

As these results will be very unexpected by many engineers on both sides of the Atlantic, we give below the leading peculiarities of the two engines. The low-pressure Great Western has her fires urged by the draft of the chimney; the high-pressure North America's fire is urged by a blowing machine. This and her other 'improvements' generally consist in 'ultraisms'—high steam, long strokes, rapid strokes—every thing in excess; and the result of all is, that only half as much effect is obtained from a ton of fuel in this engine as in those constructed on the "other side of the Atlantic," but which, as we have already seen, are capable of very great improvement, while the former is said to be nearly 'perfect' by those who never took the trouble to inquire into the matter, deeming an investigation as troublesome and useless as their presumed superiority was modest and unostentatious.

After all, the improved use of steam in navigation is but a branch, though an important one, of the extensive improvement of the steam-engine we have advocated and described in general terms at page 170, as thus "almost every factory engine in existence, every locomotive that runs, or steam-boat that floats, may be improved either in economy, power, or safety."

The factory engines in common use in this country being high-pressure, may be readily improved, and at little cost, by substituting larger cylinders and proper slide movements for those now employed; thus but little additional expense being needed for the improved engine, while half of the boilers and fixings, and space therefor, being saved, the actual joint cost for engine and boilers will be less for the improved than for the present engines, and a clear saving of full half the fuel and labor for its unnecessary destruction, will be actually gained as a profit. Or the same boilers and fuel being applied to furnish steam to an improved engine, costing but a trifle more than the present unimproved one, full double the power will be derived by the process recommended, and with but a trivial additional outlay.

The same improvements may be applied to locomotive engines of every kind, with the further advantage of saving half the water as well as half the fuel, and the cost of the transportation thereof. Or the same fuel and water that are used in the present engines, will enable the improved engine to travel with double power, or to twice the distance: in either and in every case, reducing the expense, and increasing the facility of locomotion in a very great and desirable degree, and by means as costless and unexpected as hitherto singularly and universally disregarded in all countries.

While this article is passing the press, a similar improvement of the locomotive engine has been patented in England, and described in the Leeds Mercury as effected on the Hull and Selby Railroad, a detail of which will be found at page 458 of this number. It will be seen from this that our anticipated improvements of the steam-engine, so far from being visionary are easily practicable; and being put to the test of experience, have been so far realized as to leave not a doubt of their value. We still, however, deduce from our previous reasoning, that greater advantages are in store than have been effected on the Hull and Selby Railroad.

Having, as we trust, fully shown that these advantages are within the reach of all; that these improvements may be effected with little cost or trouble, and with great eventual profit; and

having also ascertained that the greatest speed in steam-boats is to be obtained at diminished cost from steam of little intensity, we may reasonably expect that this country will soon be relieved from a bitter and destructive curse, as profitless, disgraceful and dreadful as the "processions of Juggernaut."

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
BOATS.	No. Cylinders.	Diameter of Cylinders.	Area of Cylin. square in.	Area of Steam Ways, sq in.	Double strokes per minute.	Length of stroke.	Speed of Piston per min.—ft	Initial Steam.	Steam cut off.	Residual steam thrown away.	Average steam pressure.	Length of Vessels—ft.	Draft of water, light, including keels.	Draft of water, loaded, including keels.	Medium diam. paddle-wheels.	Breadth of Beam.
N. America	1	42	1385.5	245.8	22	11	484	65	$\frac{1}{3}$	21.66	45.32	210	4.5	5.0	28	25.5
G. Western	2	73	8370.8	324.0	15	7	210	See Diagram.				220	12.5	17.5	28	33.5

COMPARATIVE DISPLACEMENTS.

North America, fuel and passengers 5
Great Western, light 19
" " loaded, and half coals exhausted .. 25
" " loaded 27

For the American Repertory.

ON THE EFFECTS OF ARTS, TRADES, AND PROFESSIONS, AS WELL AS HABITS OF LIVING, ON HEALTH AND LONGEVITY.

No. VI.

Having considered the effects of exercise within normal or healthy limits, we are now prepared to examine more particularly the influence of over-exertion upon health and longevity.

As a general rule it will be found true that over-exertion, like confinement, proves most injurious the earlier in life it comes into operation. In childhood the bones are not fully ossified, nor the frame consolidated; the fluids bear a much larger ratio to the solids than at the age of manhood, and the vital energy is required in the performance of the various functions on which the growth of the body depends. Hence, if the vital force be inordinately expended in muscular contraction, the growth ceases, and deformity is produced. The muscles contain less fibrin at this period than at a more advanced age, and accordingly are unfitted by their organization for violent or continued

action; and if it be imposed upon them beyond moderate limits, they are certain to pay the penalty in speedy debility, with serious injury to the other functions, both of animal and organic life.

We have already alluded to the evils attendant upon the factory system of England, where children of a tender age are employed; and in addition, we may observe, that few if any of these attain to old age. Mr. Marshall, the Superintendent of the Home Manufacturing District, remarks, that in this extensive district, comprehending London, Halifax, Huddersfield, Leeds, &c. he did not find three persons of the age of 60 employed in the factories of wool, cotton, flax and silk. At 30 and 25 a man and woman are considered to be old. "Nay," he adds, "they are actually aged, so far as that is denoted, by decrepitude, disease, and want of physical power."

Besides being employed in cotton and woolen factories, children are also extensively engaged in Great Britain, as well as other parts of Europe, and to some extent in this country, in various other branches of trades and manufactures.

In a speech delivered August 4th, 1840, before the House of Commons, Lord Ashley stated that a greater number of children were engaged in these than in the factories, of which he designated the following, viz. manufactures of earthenware, porcelain, hosiery, pins, needles, arms, nails, cards, &c. and in iron works, forges, founderies, glass, collieries, bleaching, paper mills, and some kinds of weaving, calico printing, tobacco manufactures, button factories, &c. In the tobacco manufacture children are employed from 12 to 16 hours a day, beginning at 7 years of age, and are almost invariably sickly. At bleaching they begin at 10 or 11 years, and work often a great portion of the night. In the potteries, the plate makers generally employ boys as assistants, whose occupation is to remove the plates to the drying houses, heated to 120 degrees; and in this occupation the boy is kept on the run from six in the morning till seven in the evening, except a short interval for breakfast and dinner. Boys are employed at an early age in printing offices, stereotype founderies, and bookbinderies, commencing often early in the morning, and continuing till late at night—

thus cutting off all opportunity for education except what may be casually picked up, or obtained in the Sunday School. In the collieries and iron mines of England, great numbers of children of both sexes are employed from the age of 7 and upwards, to the ruin of their health and morals. In framework knitting, a department of lace manufacture, a business as yet but little introduced into this country, about two-thirds of those employed are children between the years of 6 and 18, who work sixteen hours a day generally, in low and confined rooms and shops, badly ventilated, filthy, and often over-heated; in short, under circumstances entirely destructive of health, comfort, and cleanliness.

From evidence given before a committee of the House of Commons, it was shown that "the hardest labor in the worst room in the worst conducted factory, is less hard, less cruel, and less demoralizing than the labor of the best of collieries." In pinmaking, where the employment is entirely sedentary, children are employed from the age of 6, ten hours in a day, with the body bent over, and the eyes, fingers and feet constantly engaged, and in rooms often crowded, filthy, and poorly ventilated. In the department of calico printing, in England, it appears from the same evidence that children of 5, 6, and 7 years of age are employed; two sets being engaged, and each working twelve hours in succession.

In the speech of Lord Ashley, from which many of these facts are gathered, it is stated that in some of the trades in Great Britain there is almost a legalized system of slavery; parents being in the habit of selling the services of their children for periods of long duration. "Several hundreds of children," he remarks, "are thus let out by their parents in many towns, to be engaged in the most laborious and unhealthy manufactures. In many instances, children not more than 5 or 6 years old are employed in these trades for from twelve to sixteen hours a day, and of course they are entirely deprived of the means of education, and at the same time their health is undermined or destroyed."

In France, also, the same evil exists to a very great extent. In February last, Baron Dupin made a report on the subject to

the Chamber of Peers, in which he remarks:—"What is the state of morality among the young children employed in the workshops? None at all: every where there is a want. It is a curious fact that the immorality seems to be greatest in those very places where the children are admitted into the workshops at the earliest ages. We were desirous of ascertaining the amount of difference in force and physical power between parties who had respectively attained the age of manhood, in the parts of France most devoted to agriculture, and those where manufacturing industry is more generally diffused. The councils of revision in the recruiting department exhibited the following facts: For 10,000 young men capable of military service, there were rejected as infirm, or otherwise unfit in body, 4029 in the departments most agricultural; for 10,000 in the departments most manufacturing, there were rejected 9930. In detail, there were found for 10,000 capable of military service in Marne, 10,309 incapable; in the Lower Seine, 11,990; in L'Eure, 14,451. These deformities cannot allow the legislator to remain indifferent; they attest the deep and painful mischiefs; they reveal the intolerable nature of individual suffering; they enfeeble the country in respect of its capacity for military operations, and impoverish it in regard to the works of peace. We should blush for agriculture if in her operations she brought at the age adapted to labor so small a proportion of horses and oxen in a state fit for toil, compared with so large a number of infirm or misshapen."

The same evils, to a greater or less extent, doubtless exist in every manufacturing country, especially where, as in England, the population is crowded, employment often scarce, and wages low. They are indeed, in a great measure, necessarily incident to such a state of society; and legislation, to be beneficial, should rather be aimed at the removal of the causes, than in the shape of prohibitory enactments and penalties upon parents, poor-law commissioners, guardians, and manufacturing employers. In a dearth of employment, where the means of living are high, and the very laws keep up the price of provisions, it is by no means strange that parents should sell the labor of their children to purchase bread. They are indeed precluded from

paying any just regard to the moral and physical condition of their offspring, for "necessity knows no law." It is therefore obvious that the best, if not the only way of correcting these evils, is such legislation as is calculated to cheapen food, and thus enable the parent to earn sufficient by his daily labor to support his family, while his children are kept at school.

These remarks, however, have reference to the state of things in other countries rather than our own; for as yet we are chiefly an agricultural nation, and experience few of the evils of the factory system. Labor is abundant, and meets with an adequate reward; education is thus placed within the reach of every child, though it is a lamentable fact, and one eminently worthy the attention of our legislators, that thousands do not avail themselves of its advantages.

But to return from this digression. It is a wise arrangement that the employment in which the mind as well as the body is engaged, is of the most healthy kind, and it is essential to health that they should always act in harmony. The intellect guides the skilful hand of the artisan, while the moral and domestic sentiments are gratified at the result of his labor. In all the mechanic arts and trades, and in agricultural labor, invention and ingenuity are in constant exercise, and the muscles execute with precision the mandates of the will. Where the laborer and artificer reap the reward of their own industry and skill, the brain sends forth its volitions with promptness and alacrity, and the muscles render a no less cheerful obedience. To "work with a will," to use a sailor's phrase, is to work with effect as well as pleasure. When labor is involuntary, and not crowned with its just reward, the will and the muscles are in opposition, and as the mind and body do not move in harmony, the conditions of healthy exercise do not exist, and disease more frequently supervenes. Where labor is compulsory, but little comparatively is effected; the muscular movements are weak and irresolute, because the will is feeble and undecided. Dr. Armstrong thus alludes to the advantages of combining harmonious mental excitement with muscular activity:—

> "He chooses best, whose labor entertains
> His vacant fancy most: the toil you hate
> Fatigues you soon, and scarce improves your limbs."—Book III.

Over-exertion may be said to shorten life in three different ways:—1. By injuring the continuity, cohesion, or relative situation of various parts.—2. By inducing that degree of exhaustion which runs on to incurable or fatal disease.—3. By that gradual and insensible expenditure of vital influence beyond the power of reinforcement, whereby the mean duration of human life is shortened.

We have already alluded to the lesion known under the name of *hernia*, or rupture, so often met with among those subjected to excessive labor, particularly to lifting great weights. In these cases, owing to over-exertion, some portion of the walls of the abdominal cavity yields, and the contents protrude, giving occasion for the employment of some mechanical means of support. *Aneurism* is another disease frequently induced by violent muscular exercise; and where it occurs in the larger vessels, it most generally proves fatal. Dr. J. Johnson truly says, that "violent exertion did great harm, even when nations were more in a state of nature than they are now. Galen, in his discourse on Thrasybulus, inveighs against the athletic practices of the gymnasium. A smart walk of a mile is to a valetudinarian what a furious wrestle would be to an athletic. If we trace those dreadful aneurismal affections of the heart and arteries in early life, we shall find their origin in violent exercise, or sudden over-exertion, in nine cases out of ten."

That serious if not incurable diseases are often produced by over-exertion of the physical powers, is a matter of almost daily observation. Indeed, most of the diseases to which the laboring classes are subject are the offspring of excessive labor, aided by intemperance either in eating or drinking.*

* A few cases which have come under my own notice will illustrate the nature of some of these diseases. A—— is a man 28 years of age, of stout athletic frame, born in Maryland. Four years ago, he sprained his back severely in lifting heavy timbers in moving a house. Pain and soreness in the spine succeeded, and he had to give up work. He has been subjected to a great variety of treatment, with but partial relief. He has not been able to perform a single day's work since. Three years ago he weighed 182 lbs.; his weight is now 150 lbs. The present symptoms are, severe pain between the shoulders and in the small of the back, often darting through the heart and different parts of the body; extreme tenderness over the whole spinal column; bowels very irregular; urine high colored and scanty; perspires very

As a general rule, after the sensation of fatigue is experienced muscles cannot be employed without great danger of evil consequences. Repose and sleep are designed to prevent excess of exercise, and the feeling of lassitude and fatigue is the test of the necessity of such relaxation. If this be disregarded, nature feels the outrage, and resents it by the infliction of pains and bodily disease.

The chief mode however in which over-exertion shortens life is, by its gradual and insensible expenditure of vital influence, beyond the power of reinforcement. We see this not only in children and young persons, who can ill bear such a drain, and who are always impatient of confinement and over-exertion, but we observe the same result in nearly all engaged in the various arts, trades and occupations of life. Man is overworked

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freely; digestion bad; tongue always furred; pains and numbness in the feet and right hand; voice so feeble as not to be able to speak above a whisper. In short, this man, hobbling with difficulty on crutches, is one of the most pitiable objects I ever beheld. He married early in life, and had three children; his family being solely dependent on his daily labor for their support. In consequence of a single day's over exertion, he became a cripple and invalid for life, depending on the cold charity of relatives for a miserable support.

B—— is a man of 30 years of age, a native of this city, and a few years since very stout and athletic, particularly excelling in feats of strength and athletic exercises. About six or seven years ago, he undertook to swim across the Hudson river, between this city and Hoboken, and back again, for a wager, which feat he successfully accomplished. But he has never been able to do any labor since. He immediately lost all command over his muscles, and he can neither feed himself nor walk, without exhibiting all the contortions of one laboring under St. Vitus's dance. There is evidently a weakness of muscular fibre, and a diminution of voluntary power in the parts affected, and the muscles become less and less capable of executing the dictates of the will. When he attempts to advance, he is thrown upon his toes and fore part of his feet, and impelled to adopt a more rapid pace to prevent falling. It is hardly necessary to add that there is no kind of work which he is able to perform.

C——, an Irishman, aged 23, a hod-carrier, had been engaged for several days in carrying brick and mortar to the third story of a very high building, was seized with excruciating pain in those muscles of the leg which are most employed in ascending heights, particularly the muscles of the calf. He has now been confined to the house several weeks. The muscles above mentioned have become nearly as hard as horn; and having lost all power of contraction, it is highly probable he will never again recover the use of them.

Numerous other cases of a similar character to these could be given, were it necessary, in illustration of the effects of over-exertion; such as rendering the muscles hard and rigid, causing varicose vessels, and chronic rheumatism, enlargement and other diseases of the heart, &c.

in them all. Too many hours are devoted to continuous toil; too few for relaxation and mental improvement; and thus labor, which we have shown when properly pursued to be a blessing to the human family, is in danger of proving a curse, and one of the most powerful causes in deteriorating the race. Instead of 12, 14 or 16 hours a day, which are now devoted to incessant exertion, from 6 to 10 ought to be considered sufficient, and are indeed for all necessary purposes of competence and independence. Were the hours of labor in all the trades and occupations to be reduced, there can be no doubt that the general results would be highly beneficial; for if the price of manufactured articles should be somewhat enhanced, that of agricultural products would be increased in the same proportion, so that the same ratio would exist as at present. Indeed, it has been doubted whether, if such a measure were adopted, less labor would be performed; for it has been observed, that as much work is accomplished in 8 hours, when it is done cheerfully and with a feeling of satisfaction towards his employer, as in 12 or 16, when dissatisfied, and conscious of being oppressed or regarded with indifference. The result of slave labor, when compared with that of freemen, may be referred to by way of illustration. Such however is the eager pursuit for wealth in our country, and such the independent condition of society, that the manufacturer, the master mechanic and agriculturist overwork themselves in an equal degree, and often with greater detriment to their physical constitution than those under their employ. Our farmers (we do not mean our gentlemen farmers) rapidly wear themselves out, and often at the age of 40 look to be 50 or 55; their muscles are rigid; their limbs and joints affected with rheumatic pains; their faces wrinkled, and their heads whitened. From daylight to dark they scarcely cease from toil; and were our days as long as those within the polar circle, it may be doubted whether many would find time to sleep till night came. We have for a long time believed that the most laborious class of agriculturists shorten their lives from ten to fifteen years by excessive labor; and the same is true of those engaged in many other occupations. Sailors are proverbially short-lived; a result owing to the combined influence of

the dangers of the sea, exposure to atmospheric vicissitudes, intemperance, and hard work, together with vicious habits, and breathing the impure air of the forecastle. The average duration of life among the Irish immigrants to this country has been estimated at five years; and we have heard a Catholic clergyman state, that during the last twenty years he has visited several thousand Irishmen upon their death-bed, but among them all there was not one over 55 years of age, and that nine-tenths of them were between 25 and 35. He attributed this excessive fatality to hard work alone; but there are other causes of equal if not greater efficiency. Most of our canal and railroad making, ditching, paving, blasting and excavating is performed by Irish laborers; and besides the casualties to which they are necessarily exposed, they are also subjected to the deleterious influence of malaria, cold, wet and ill-ventilated or ill-warmed apartments —and above all, they generally indulge in the free use of intoxicating drinks.

To illustrate what we mean by the shortening of life through the gradual and insensible expenditure of vital influence, we may refer for example to the cart or stage horse, who is worn out before he has reached half the natural period of his life. In a few years, sometimes in three or four, his limbs become stiff, and almost inflexible; the muscles no longer contract with facility; his strength fails, and he is turned out to perish, or is destroyed. England has been called "the hell of horses," from the excessive labor to which they are there subjected; which labor, says Mr. Lawrence, "has curtailed their length of days." Again he remarks: "Under more favorable circumstances, both their age and their services might be greatly prolonged. The writer, some years since, saw at Dulwich two geldings—the one 48, the other 54 years of age, both of them capable of performing some light daily labor. From the excessive and cruel system of labor adopted, against all feeling and conscience, horses are torn to pieces before their tenth year: and if they miss the benefit of slaughter, they seldom survive their twentieth."*

In the same manner, by the wear and tear of hard work and

* "The Horse, in all his Varieties and Uses," by John Lawrence.

the influence of the depressing passions, the vital properties of every human organ are exhausted; the mysterious vital energy which is imparted in a given portion to each individual at birth is slowly and insensibly diminished, till at length it is reduced below the amount necessary for the successful prosecution of active toil. Nourishing food, rest, and sleep tend to restore it in some good degree; but a certain portion is daily taken from the fund of life, and the vital capital is reduced in proportion to the lavish expenditure. "However proper the nature and condition of our aliment; however completely all our laws of external relation are fulfilled; however perfectly the functions of our organs are performed, and however salutary their results, —yet every digestive process of the stomach, every respiratory action of the lungs, every contraction of the heart, draws something from the ultimate and unreplenishable resources of organic vitality; and consequently the more freely and prodigally we expend the vital properties of our organs, the more rapidly we wear out the constitutional powers of replenishment, and exhaust the limited stock of life."

[For the American Repertory.]

ON THE LATENT HEAT OF STEAM.

(CONTINUED.)

To prove the utter fallacy of the new theory suggested by your correspondent with regard to latent heat, it will be sufficient simply to point out the remarkable fact attending the transition of water into steam. Provide a small cylinder having a tight piston, the weight and friction of which is duly balanced by a counter weight or other contrivance; let a small portion of the cylinder be filled with water of about 60° temperature, and let the piston rest upon its surface; insert the bulb of a thermometer into the bottom of the cylinder, so as to give a correct indication of the temperature of the water contained in it: the apparatus being placed above a lamp or fire supplying a uniform heat, the effect will be that the temperature will gradually increase until it arrives at about 212°, when the curious phenomenon will be observed, that, notwithstanding the con-

tinued application of fire to the bottom of the cylinder, and which will, it must be conceded, continue steadily to impart more heat to the water within, no further increase of temperature will take place until the piston has moved so far upwards as to leave a space below equal to about 1700 times the volume of the water put into the cylinder. Now let us reflect what has become of all the heat which must have been imparted to that water during the time that the thermometer has remained stationary, and which will be found to amount to nearly five times as long a period as that which elapsed in raising the temperature up to 212.° To this must be added the important fact, that the contents of the cylinder will, on accurate weighing, be found the same after this great accession of heat as it was when the thermometer ceased to indicate any farther rise: in other words, no addition of ponderable matter has taken place whilst the thermometer has been stationary, and still during that period about five times as much heat has been imparted to the water in the cylinder as that which raised its temperature to the stationary point of 212°! What, then, can be more correct than to say that the heat thus taken up in converting the water into steam, without any perceptible effect on the thermometer, has become *latent*? The term is really unexceptionable—the popular definition of *latent* being "hidden," or "concealed." Your correspondent's definition, to judge from his reasoning, must be very different, as he wishes us to believe that nothing short of *annihilation* can be meant by the acknowledged term *latent*, as applied to heat. And in pronouncing judgment on those who are of different opinion from himself, he exclaims: "We see their joint errors are founded alike on misapprehension of the true nature of heat in steam, in which none can be *lost* or become latent with any degree of expansion within a steam-engine."

Although intimately acquainted with a large body of practical men in Europe, I have not yet met with even one individual who thinks that heat is "*lost*" by the expansion of the steam: still less does the insinuation apply to the practical men of the United States, who are all well acquainted with, whilst they most advantageously employ, the expansion of steam. The alledged "misapprehension," therefore, exists only in the ima-

gination of your correspondent; and I believe we have yet to learn who that theorist is who thinks that heat "becomes *latent* by expansion," for it is in the *formation* of steam that heat is rendered latent or insensible, and by condensation that heat is made free, not "*lost*."

Before exposing the absurdities of the practical illustrations presented by your correspondent in support of his new theory on latent heat—a theory by which he has "removed an incubus that has long pressed so heavily on, and retarded so much the advancement of this particular branch of science"—I will briefly notice his remarks about the permanent gases, the tendency of his observations being that of still further obscuring the subject of the latent heat of steam. He admits that the term latent heat may be applied to the permanent gases, these being in his opinion in all respects unlike steam; and the direct inference from his reasoning is, that their heat is not at "any density whatever free; not perceptible to the sense of feeling; not appreciable and measureable by the thermometer; not prone or ready to enter into instantaneous combination with any colder substance." Now, the great distinguishing feature of the permanent gases is, that their expansive force is always uniformly increased by uniform additions of heat, that is, their force is at all times in direct proportion to the temperature as indicated by the thermometer; the reason being, that heat imparted to permanent gases does not become latent, but remains in a free sensible state. The *direct* proportion between pressure and temperature as exhibited by these gases, furnishes an additional strong argument in favor of the term *latent heat* as applied to steam, in contradistinction to the free sensible heat of the permanent gases. I must, however, observe that these remarks are confined to the changes only which we are capable of subjecting these gases to. Various reasons favor the supposition that atmospheric air and other permanent gases are vapors of highly volatile bodies which vaporize at extremely low temperatures; their latent heat is therefore a subject which, in a practical point of view, is quite unimportant, and to which the foregoing remarks have no relation.

I will now proceed to notice the practical demonstration pre-

sented in the form of a diagram, (see the number for September, page 91,) the infallibility of which your correspondent relies upon in his endeavor "to correct or uproot existing errors, to obtain increased and extended real information," by which he "clears the mind from what is mistaken, removing obscurity by intelligible statements alone," and by which he so confidently claims the merit of being "truly and practically useful to society, substituting *plain facts* and *substantial truths* for the uncertain theories and certain errors hitherto prevailing."

We are instructed to fill the short end of a bent glass tube with mercury, after having first introduced a small quantity of water, and we are told that by immersing this short part of the tube, which is to be 6 inches long, into boiling diluted sulphuric acid kept at a temperature of 320°, the water contained in the short end will be converted into steam, and if an undue quantity of water should be introduced that it will pass off through the mercurial column, which, by the pressure of the steam, will be forced into the long portion of the tube. The vapor remaining in the short end is then supposed to possess the natural properties of *steam*, of an elasticity that will balance a column of 37 inches mercury, including of course the pressure of the atmosphere.

That the vapor thus formed in the tube will, by containing an undue quantity of caloric, be of a different nature from steam formed over a body of water, must appear evident to every one possessing only a superficial knowledge on the subject, and the incorrectness of the assumed similarity may be proved in the most conclusive manner by reducing the temperature of the bath to that temperature which corresponds to the 37 inches column, that is about 222°, when it will be found that the *vapor*, without any portion forming into water, contracts into about $\frac{3}{4}$ of the space occupied whilst exposed to the temperature of the acid; it will then become *steam* possessing all the properties of steam generated in a steam-engine boiler. Truly has your correspondent said that "the obscurity of this branch of science, and the contradictory opinions thereon, frequently amount to *infatuation*," for, in my opinion, no other reasonable explanation can be given to account for his attempt at overturning an acknowledged philosophical principle by a demonstration founded

so completely in error as his vapor generator in the diluted sulphuric acid bath, which instrument, from obvious reasons, gives a false result as to the relative amount of pressure, density and temperature *at every degree of the scale*, excepting when the mercurial column happens to be about 180 inches high, when the temperature of the bath corresponds to the pressure and density of the vapor in the tube.

Having thus explained the radical defect of this instrument *contrived for disproving the existence of latent heat in steam*, I need not refute the deductions, since being founded on erroneous data they merit no consideration. J. E.

[Reported for the American Repertory.]

Analysis of a Lecture on Moral and Physical Education, delivered before the Mechanics' Institute in the City of New-York, November 23d, 1840. By JOHN B. SCOLES, *Esq.*

THE aim of the lecturer was to show the nature and importance of moral and physical education; both of which he insisted have been too much neglected. He entered into an analysis of the powers of man, which he divided into intellectual, moral and physical; and combated with great zeal and force of argument, the common error of considering a cultivation of the intellect the sum and substance of education. Mr. Scoles insisted that a complete education must include the whole man, and call into exercise his every faculty; and that to produce virtuous character, our education must be brought to bear directly upon the moral energies of our nature; and we must not trust to the education they may receive through the medium of the intelleet. That this indirect cultivation of the moral faculties cannot be relied upon, he proved by familiar illustrations, and by appeals to observation and experience. He also maintained, that each faculty required a cultivation of its own, and that by calling into exercise one virtue, we did not thereby produce the result of virtuous character; while he admitted that the virtues exerted a reciprocal influence upon each other. By making a man benevolent, for instance, we did not necessarily make him conscientious; and so on the other hand,

the strictly conscientious man might have very little benevolent feeling.

On the subject of physical education, the lecturer traced much of the corporeal and mental debility with which mankind are afflicted, to a neglect of proper exercise, and a disregard of the laws to which our organization is subjected. He compared our practice in this respect with that of the ancients, particularly the Greeks, and considered theirs the most rational; and that to this cause was mainly attributable "those beautiful proportions of the human frame divine that yet live in the precious remains of Grecian art." He observed, "the Grecian sculptor modeled from the living forms that moved in native grace around him. This was the school in which to acquire that knowledge of the beautiful which modern imitators have called *ideal*. Active exercise in the pure air, and under the bright skies of that genial clime, braced the nerves, expanded the muscles, and rounded the form, while it quickened the senses and the intellect. The lively Greek was accustomed to put forth his muscular strength in bold but amicable contention; and he delighted in the full enjoyment of the green earth, the blue heavens, the sun-lit sea, and all the varied glories of his own favored land. Homer's immortal epic was pronounced to an admiring multitude collected together at their national games; and even the young disciple of philosophy listened to the uttered wisdom of the sage amid the groves of the academy."

The doctrine maintained by Mr. Scoles is, that the intellect must be properly cultivated so as to impart to an individual a requisite knowledge of the laws by which his intellectual, moral, and physical being is to be regulated; but that all his faculties must be trained to an observance of them; and that without this, all the knowledge of those laws which you can give him will be of very little service towards the production of virtuous character. Strict moral and religious discipline he earnestly advocated. It should accompany all our intellectual instruction. Without it, popular education will not produce the effect of elevating the character and improving the moral condition of a people, which some so confidently but most erroneously anticipate. Mr. Scoles dwelt with eloquence upon the mother's influ-

ence in the cultivation of the moral impulses and the formation of character. He appealed to consciousness and experience for the truth of his position, that the impressions made by her upon the infant mind and heart are never wholly obliterated ; and he brought forward the admissions of some of the greatest men of our own and other countries, as to the maternal influence of which they were the subjects.

The lecturer investigated the causes of mental alienation and moral depravity—tracing them to disease, bodily weakness, ignorance, strength of propensity, deficiency of moral energy, &c. In seeking to remedy the evil, he urged the necessity of ascertaining the true cause in each individual instance, and applying ourselves directly to it ; and not to suppose that the same *moral* treatment any more than the same *medical* treatment will answer in every case. It would be as rational to say that man was subject to but one disease, that admitted but of one remedy —as to say that all moral obliquity could be removed by the self-same means. Our observation of facts and our own experience are against it. What produces the greatest effect upon one man, another receives without the least emotion. What has been instrumental in the moral reformation of one man, hardens another in his guilt. This is the sufficient reason why so many well-meant but ill-directed attempts at moral correction fail so lamentably in producing the desired results. They are not adapted to the moral disease or the individual peculiarities of the person to whom they are addressed. Need we wonder, therefore, that they fail of success ?

These are Mr. Scoles's views, which he sustained by argument and illustrated by many examples. He remarked, in conclusion, that he did not ask their adoption, but merely presented them as a theme for consideration and reflection. He believed them to be in accordance with the discoveries of physiology and the dictates of sound philosophy; and what is of still higher importance, in perfect harmony with Divine Revelation. We commend them to our readers, as worthy of earnest and serious thought. Even if they do not come to the same conclusions as the lecturer, reflection upon this most important subject cannot but prove beneficial.

THE FINE ARTS.

National Academy of Design.—The winter or academic session of the society is now in full operation. The schools (supported by the funds of the institution) for drawing from the antique, and "living" models, are attended by full and effective classes. These extensive means for studying the grammar of the art will close early in the spring, for the purpose of giving place to the annual exhibition, preparations for which have been made on a more than liberal scale. Of the advantages now offered by the Academy to artists, for the proper exposition of their works, and of the pictures in progress for the forthcoming display, we shall speak hereafter. We wish now to call attention to the advantageous offer made on the part of the society, of a premium for the encouragement of the study of "design." The following are the details as published by the Academy:

Resolved, That the Academy grant a premium of one hundred dollars for the first best, and another premium of fifty dollars for the second best Historical Painting on the following subject, from Thatcher's Lives of the Indians, vol. i, p. 181, (Harper's Family Library edition):

"Canonicus (chief of the Narraganset tribe) sent a herald to Plymouth, who left a bundle of arrows inclosed in a rattlesnake's skin—the customary challenge to war. The Governor dispatched a messenger in return, bearing the same skin stuffed with gunpowder and bullets, assuring the chieftain also, that if he had shipping, instead of troubling him to come as far as Plymouth to gratify his wish for fighting, he would have sought him in his own country; and furthermore, that whenever he did come he should find the English ready for him. This resolute message had the desired effect, and the Sachem's superstition confirmed it. Fearful of some mysterious injury, he refused to touch the skin, and would not suffer it even to remain in his house. It passed through several hands, and at length was returned to the colony unopened."

Competitors will please observe the following regulations:

1. All artists, except Academicians of this or any other Academy, to be allowed to complete.
2. All paintings for competition shall be sent to the Academy on or before the last day of March next, free of expense.
3. All paintings so presented shall be arranged by themselves.
4. Premiums to be declared two weeks before the close of the annual exhibition of the Academy, by the Council, at a special meeting called for that purpose.
5. The sketch of the painting receiving the premium shall be presented, to become the property of the Academy.

6. No picture will be received unless a written declaration shall accompany it, stating that it is for competition, and that the same is the bona fide composition and execution of the artist so presenting it.

7. If none of the pictures should in the opinion of the Council possess sufficient merit to be entitled to the premium, the Council may at their option withhold it.

8. The size of the picture to be not more than eight, nor less than seven square feet.

The picture to remain the property of the artist.

We cannot conclude this article without expressing our regret that the Academy should have discontinued the system of lectures so ably commenced by them some years back. They are and always have been supplied with competent professors in the various departments of art, who are willing to devote their talents to this object, and it is due to the institution and the public that they should be called forth. The arts of design are among the few subjects within the scope of this popular mode of conveying information which have not been entirely exhausted.

J. G. Chapman, N. A., an artist intrusted with the execution of one of the four Government pictures, painted by order of Congress, for the Rotunda of the Capitol, has completed his task, and his work now graces the place destined to receive it. The subject is the Baptism of Pocahontas. We have not seen the picture, and cannot therefore speak of its merits. It has, no doubt, received the full benefit of the artist's skill. The principal personages represented in the work are: Pocahontas, Nantiquas (brother to Pocahontas), Sister of Pocahontas, Opechancanough, Opachisco; Sir Thomas Dale, standard bearers, &c.; Alex. Whitaker, John Rolf, Capt. Argall, Richard Wiffins, Mr. and Mrs. Forrest, Henry Spilman, John and Ann Leydon, sergeants of the guard, &c. The following extract, taken from a description of the picture published by the artist, will give some idea of the subject selected by him for the exercise of his pencil, and the manner in which he has treated it:

It was a memorable Sabbath morning when the sound of the church bells echoed through the silent forests about Jamestown, to gather to its consecrated aisles—the first dedicated to the worship of the living God in British America—the pioneers of civilization and Christianity in the new world, to witness the sublime spectacle of this converted hea-

then girl Pocahontas, the daughter of Powhatan, "the first Christian euer of her nation," turning from her idols to God. * * * * *

In obedience to the regulation of the town, the captain of the watch had gone his usual round, to "shut the forts and place centinells, and the bell hauing tolled the last time, had searched all the houses of the towne, to command euery one, of what quality soever (the sicke and halt excepted) to repaire to church, after which he accompanied all the guards with their armes (himselfe being last) into the church, and laid the keys before the governour." The sergeants took their stations, and the Indians gathered about the place of ceremony, as Rolph supported his destined bride to the rude baptismal fount hewn from an oak of her native forest. Nantiquaus, her favorite brother, whom Smith calls the "manliest, comeliest, boldest spirit he euer saw in a saluage," stood nearest to her of her own kindred; an elder sister, with her Indian boy, sat in mute, anxious interest and curiosity in front; while her uncle, the sullen, cunning, yet daring Opechankanough, shrunk back, and probably even then brooded over the deep-laid plan of massacre, which he so fearfully executed years after, when that spotless Indian girl had gone to reap her reward in heaven.

The Book of Prayer is closed; for not until after that time was there an established form for the baptism of those of riper years in the service of the Church of England. She bears upon her forehead the record of her vow; she renounces the idols of her nation; has confessed the faith of Christ, and is baptized. The Indian child clings closer to his mother, as the snowy mantle of swan-skin, tipped with a gay plumage that may be still seen among the thickets and along the shores about Jamestown, falling from her shoulders, discovers to her own the costume of her adopted people, and an unguarded movement of momentary excitement among the savage spectators is repeated through the congregation, as hands fall instinctively on match-lock and sword-hilt. It is the moment of the picture. Another—and she is received into the fold of Christ, as pure and beautiful a spirit as ever knelt at his holy sacrament.

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In the execution of the picture, the artist has been governed by the best authorities as to facts and details, and has made all the research within his power, in England as well as our own country, for information with regard to the subject; and in some points he may have sacrificed the picturesque for the sake of historical truth, to which he has endeavored to adhere.

To those only familiar with the churches of our own time and country, the interior of that represented in the picture may appear strange. It was adopted from one now in existence, built about the time of that of Jamestown, with such variations as the means and facilities of the colonists would most likely occasion, and the description of an actual resident of Jamestown at that period (William Stratchy) suggested. The pine columns, almost as they came from the forest, the freshness of the material throughout, and the attempt of a style connected with their associations in their native land in the construction of their chapel, are peculiarities that naturally suggest themselves, and authentic resources have supplied the rest. "The greene veluet chaire, with a veluet cushion," of the governor, "with a cloath spread on a table before

him, on which he kneeleth;" "the font, hewn hollow like a canoa;" the pulpit, with its cloth embroidered with the arms of Virginia, and initials of king James; the hourglass, &c. &c.; the martial character of Sir Thomas Dale, and the regulation of the colony that obliged the colonists to wear their arms even to church; the courtly etiquette that existed, even at Jamestown at that early day, when the governor went forth "attended with his counsailers, captaines and other officers, and a guard of holberdiers to the number of fiftie in his lordship's liuerie," with his standard-bearer and page; the younger sons and cousins of nobility at home that might be there seen, with the sturdy husbandman, the vine-dresser, the mechanic, and more energetic adventurer and soldier; the ordinance that deprived the Indian of his weapons before he entered the palisades that surrounded the town; the naked limbs and costume of the savages;—are matters of history, which the artist has only followed with the best of his ability.

John F. E. Prudhomme, A., one of our first artists, has just finished a very beautiful engraving of Bishop Chase. The likeness is considered perfect, and the engraving is of the highest order. We understand the proceeds arising from its publication and sale are to be applied to the benefit of the Jubilee College, of Illinois.

T. Cole, N. A.—The beautiful pictures of "The Voyage of Life," by this artist, described in our last number, are, we presume, ere this delivered to the parties for whom they were painted. The amount paid for this noble work is said to be five thousand dollars.

C. R. Leslie.—We understand that this gentleman, whose reputation as an artist stands so deservedly high, has received for his picture portraying a part of the ceremony of the coronation of Queen Victoria, the sum of £5000 sterling, and the further sum of £1000 from a publisher, for the privilege secured by copyright of having the work engraved.

George Harvey, A.—This artist has issued proposals for publishing "forty atmospheric or historic views of American scenery." We have had the pleasure of examining many of the beautiful and minutely finished drawings of this series, and can add our feeble testimony in favor of their great merits. The approbative letters of Allston, Morse and Sully, accompanying the prospectus, however, place the question of their excellence

beyond the reach of cavil. The work, when complete, will constitute a valuable addition for the portfolio of the artist or amateur.

Registration of Designs.—A petition to "secure the right of design" to artists and designers, will probably be submitted to Congress during the winter. The council of the National Academy of Design, as the representative of the interest of many of our artists, should examine the matter, and see those interests properly guarded. C.

ELECTRICITY IN STEAM.

During a late visit to Philadelphia, we witnessed at the U. S. Mint a few experiments made by Dr. Patterson, Franklin Peale, Esq. and Mr. Saxton, relative to the electricity in steam. These experiments were conducted in presence of Professors Hare, Torrey, Rogers, and several other gentlemen.

The steam issued from a small cock on top of a high-pressure boiler, at 50 lbs. per inch. One of the company, standing on an insulated stool, held his hand in the steam at about 18 inches from the cock; on touching the other hand to the knob of a Leyden jar, it became highly charged. Persons not insulated, touching him, received very powerful sparks.

It has been argued by some that this effect is caused by the friction between steam and the atmosphere. This has been clearly disproved by one of Mr. Saxton's experiments. He connected a leaden pipe to the boiler, and after coiling the other end in an insulated tub of water, suffered the steam, without coming at all in contact with the atmosphere, to pass through the pipe and into the water, as fast as the latter would condense it: the water, upon testing it after the operation had been conducted a few minutes, was found to be highly charged with positive electricity.

In these experiments the electricity became apparent only at the moment of condensation of the steam. When the steam was taken from the upper guage cock, it would not yield a spark—probably from its being too near the surface of the water to be sufficiently free from moisture.

MECHANICS' INSTITUTE—DRAWING CLASSES.

This institution has added another branch of instruction to those we have before noticed. There are now two drawing classes forming—one for mechanical drawing, and the other for drawing from the antique.

The importance of the latter subject has long been overlooked, both in England and in this country. The French mechanics, however, have better understood its usefulness; and hence the beauty of French mechanical designs. The mind of the artisan becomes imbued by such practice with beautiful and classic forms, and its effects are found pervading all their works.

Our readers are well aware that we have long advocated the necessity of combining the arts of design with the mechanic arts; and, despite of all opposition, we shall continue to keep the subject fairly before them.

We have occasionally heard it remarked, that the time of an apprentice could be more usefully employed than in learning *mere drawing;* that more solid branches of education would prove of greater utility. If it were proper that the *whole time* should be applied to practical purposes, perhaps the argument might prove tenable; but it is not so. The mind of youth not only requires relaxation and variety, but also to be occasionally so employed as to amuse without wearying its energies. Those who manufacture hats, shoes, wearing apparel, &c. are unwilling to acknowledge the applicability of the arts of design to their manufactures; and while they freely admit its utility to the architect, the machinist, the cabinet maker, and upholsterer, believe it to be totally inapplicable to their particular vocations. So did the potters, previous to the time of Wedgewood. Suppose a taste such as was possessed by Canova, Chantry, Flaxman, or Lawrence, to have been applied to designing the form of a hat, shoe, or coat: Would it not have procured a preference over the mere creations of a fashion-changing shopkeeper, void of educated taste or the ready means of applying what he may have possessed? It cannot be doubted: the fact is too obvious to admit of dispute. Look at the tin-work of the French: the

beautiful forms selected for household utensils naturally excites the artisan to superior workmanship; and in consequence, we find the silversmiths of England and America copying the patterns designed by the French tinmen.

We cannot cite a stronger instance of the useful effects anticipated by such classes, than the beautiful *iron railings* used at present in this city. Formerly the railings were straight rods of iron, pointed at the top, void of beauty or symmetry. A German blacksmith, Mr. Paulus Hedl, who had been taught drawing when young, first ventured to make an ornamental railing: the consequence has been that he has retired from business with a competency, and all are willing to follow in the path which he has laid out for them.

The classes we have before referred to will meet at the Institute two evenings in each week; and several members, competent to the task, have volunteered to give the necessary instructions. Those who may wish to join either or both the classes, will please hand their names to the Librarian at as early a date as practicable.

WROUGHT-IRON STEAM PIPES.

We are glad to find that with our manufacturers this article is daily superseding the ordinary copper pipe, than which it is much stronger, less expensive, and less liable to accidents.

Where copper pipes are used to convey steam, the joints are brazed, and soft solder wiped on the outside, to stiffen the connection, and prevent the brazing from giving way. The frequent heatings and coolings the pipes are subjected to when used for high steam, and the unequal expansion of soft solder and copper, cause these joints soon to become abraded; and as the brazing cannot be renewed without much loss of time, the soft solder joint is renewed again and again, until after one or two years thorough repair becomes necessary, which is nearly as expensive as the first cost.

Wrought-iron steam pipes, such as are now sold in this city, are capable of sustaining a pressure of 3000 lbs. per inch. When heated, they can be bent to any form. They are made

to screw readily into each other; and thus, from having no other metals connected with them, are not liable to leak from sudden changes of temperature.

NOTICES OF NEW PUBLICATIONS.

Hale's United States;—being numbers CXIX and CXX of the Family Library. 2 vols. 8vo. New-York: Harper & Brothers.

This work was received at so late a period that we have only had time to peruse the first volume. The historical facts in relation to the discovery of this continent are most accurately given, and the author appears to have labored hard in collecting incidents not generally known. From what we have read, we would cheerfully recommend it as being worthy a place in the Family Library.

TO SUBSCRIBERS.

The present number, as you are aware, completes the first year of this journal's existence. With the experience of the past before us we find it necessary, ere the work enters upon another year, to say a few words respecting the terms of payment. At the time of commencing the Repertory, it was thought advisable to place the price as low as possible, for the purpose of increasing the circulation of the work, and thereby its usefulness. With the present number of subscribers, we shall cheerfully continue it at the same price, but find it necessary so to alter the terms as to secure the payment of the subscription in advance, as originally set forth in our prospectus. Therefore, for the future our terms will be *four dollars per annum payable in advance, or five dollars per annum if paid after issuing the third number from the date of subscription.*

The necessity for such an arrangement must be obvious, when the price of subscription is so small, as is the case with this journal, that the expense of collection far exceeds the profit on those amounts which are not paid when first called for by the collector.

PROGRESS OF SCIENCE.

Magnetism of Chronometers. A Letter to the Editor of the Nautical Magazine. By G. B. Airy, *Astronomer Royal.*

The subject of the magnetism of chronometers has occasionally engaged your attention. Perhaps you may take some interest in the following account of a rate of a thermometer, subject, in a greater degree than any other which I have examined, to the influence of magnetism; and of the process by which this fault has been nearly corrected.

In the month of September last, the chronometer Brockbanks, 425, the property of the government, was returned to the Royal Observatory, Greenwich, by Messrs. Brockbanks & Co. with a statement that the chronometer appeared sensible to magnetic action, as its rate was distinctly altered when the chronometer was placed near to an iron door. It appeared desirable to institute an accurate examination into the effect of terrestrial magnetism upon its rate; and for this purpose the following process was used: The chronometer was compared every day with a clock, whose error was accurately known from transit observations, (in the usual chronometer system of the Royal Observatory) and after each comparison it was turned 90° in azimuth, always in the same direction as the motion of the hands of a watch. The smallest acquaintance with the theory of the action of magnetic forces upon the balance or balance-spring, will convince any one that observations made with any part of the chronometer in the four cardinal positions, will exhibit the effects of magnetism, as completely as if it had been turned successively to every point of the compass; and, indeed, that they will enable us to predict accurately the rate which the chronometer will have when turned in any other position. And, as the cycle of observations embraces only four days, (or five days, when, as usually happens on Sundays, a day's comparison and one turn of 90° are omitted) the comparison of rates will scarcely be affected by these gradual changes of rate to which all chronometers are liable. The position of the figures XII, on the chronometer face, with reference to the astronomical meridian, was registered after each change of position.

The following abstract (containing the means of the rates in the different positions of the chronometer) will show the amount of the influence of terrestrial magnetism:

Mean daily rate, figure XII,	......North......	—4·64s.
" " "	......East........	—8·70s.
" " "	......South.......	—9·61s.
" " "	......West	—5·71s.

The mean daily rate with figure XII, in any azimuth A, measured from the north towards the east, south, and west, would therefore have been

$$-7{\cdot}16\text{s.} + 2{\cdot}48\text{s.} \times \cos A - 1{\cdot}50\text{s.} \times \sin A.$$

The smallest losing rate would be —4·26s. when the figure XII was N. 31° W.; and the greatest losing rate would be —10·06s. when the fig.

XII was S. 31° E.; the greatest difference of rates depending on the position of the chronometer being 5·80s.*

The amount of magnetic influence being thus determined, it then became necessary to consider how this influence might be reduced or annihilated. There appear to be but two principles upon which this can be done.

One is, to destroy the internal sensitiveness of the chronometer to external magnetic action. This is the only way by which the possibility of magnetic disturbance, under all circumstances, can be radically destroyed. I see no practical method of effecting this but by the expensive process of removing the balance and balance-spring, and substituting new ones. It is however much to be desired that some person conversant with practical operations of magnetism should endeavor to make practicable the destruction of permanent magnetism in the balance and springs of chronometers, as mounted in the instruments.

The other principle is, to neutralize the terrestrial magnetism by introducing another antagonist magnetic force. This may be done with great facility, by reference to the following consideration:

The earth, so far as its action on magnetic substances at any one place is concerned, may be considered as a huge magnet, having its marked end towards the south. This will be evident, if we remember that the opposite poles of different magnets attract each other; and, therefore, as the marked end of a magnet is attracted to the north, the unmarked end of the great terrestrial magnet which attracts it must be on the north side, and its marked end on the south side.

If therefore a magnet be suspended freely, as the needle of a common compass, it will assume a position in which its poles are opposed to the poles of the terrestrial magnet.

Consequently, the compass-needle and the terrestrial magnet act in opposite ways upon any other body subject to their magnetic influence; or, the effect of the compass needle will tend to neutralize, or to reverse the effect of terrestrial magnetism.

And, therefore, by proper adjustment of the distance, the magnetic action of the compass needle upon any other body may be made to correct the magnetic action of the earth on the same body.

The practical construction which this suggests is extremely simple. *The action of terrestrial magnetism upon a magnetic chronometer may be annihilated by placing the chronometer upon the top of a compass-box, whose needle is perfectly free, provided that its elevation above the compass be properly adjusted.*

It is easy to make a trial of the principle of this correction, thus: place a small compass upon the glass cover of a large compass, and the marked end of the small one will point to the S. Elevate it to a great distance above the large one, and its marked end will point to the N. Raise it gradually from the glass, blocking it up with pieces of wood copper coin, pasteboard, &c.; and a position will at last be obtained in

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* These numbers are thus obtained: 7·16 is the mean of the rates in the four positions; 2·48 is half the difference of the N. and S. rates; 1·50 is half the difference of the E. and W. rates; $5{\cdot}80=2\sqrt{(\overline{2{\cdot}48^2}+\overline{1{\cdot}50^2})}$: and $\tan 31^\circ=\frac{1{\cdot}50}{2{\cdot}48}$ nearly.

which the needle of the small compass will rest in any direction. This is the elevation at which the magnetic part of the chronometer ought to be placed in order that the effect of terrestrial magnetism may be entirely corrected.

Exactly in the method which I have described, I proceeded to correct Brockbanks, 425. Having ascertained the elevation at which a Kater's compass neutralized the terrestrial magnetism, and having measured the distance of the chronometer balance (in which I supposed the magnetic part to be situate) above the base of the chronometer case, I constructed a wooden box or dish, with ledges for the support of the chronometer box, and with a central hollow or well for the compass, and I so adjusted the elevation of the compass, that the balance of the chronometer might be (as nearly as I could arrange) at the same elevation as the needle of the small compass had been when its directive power was destroyed. The chronometer was then rated as before, being turned 90° after every comparison; the following are the means of the rates:—

Mean daily rate, figure XII....North....—6·90s.
" " " ....East.....—8·10s. one day only.
" " " ....South....—8·17s.
" " " ....West....—6·75s.

The discordance in different positions was thus greatly reduced, but the residual part was of the same kind as the original discordance. It appeared, therefore, that the action of the compass was too weak, or that it was too far depressed below the chronometer. It was therefore raised a quarter of an inch, and the chronometer was again rated. The following are the means of the rates:—

Mean daily rate, figure XII....North....—7·96s.
" " " ....East.....—9·20s.
" " " ....South....—9·54s.
" " " ....West....—8·41s.

As the remaining error was still of the same kind, the compass was again raised a quarter of an inch, and the results were as follows:—

Mean daily rate, figure XII....North....—9·24s.
" " " ....East.....—9·41s.
" " " ....South....—9·75s.
" " " ....West...—10·03s.

It now appears that the chronometer is over-corrected; but so little, that it may be considered for all practical purposes, as free from magnetism. The small irregularity which remains does not follow the same law as that of the original magnetic disturbance, which I ascribe to the following cause: Upon taking the chronometer from its wooden ledges, I usually found that the compass was left in the state of vibration through a small arc. I infer from this, that the steel-work of the chronometer had deranged its position, and therefore, it could not exactly correct the terrestrial magnetism. This circumstance points out the advantage of using in similar cases a powerful compass, which will bear to be removed to a considerable distance from the chronometer.

I am somewhat surprised at the necessity, which in this instance has become quite certain, of bringing the compass nearer to the balance than was necessary for destroying the directive power of the small trial compass. The uncertainty of measures cannot amount to half an inch; the only probable explanation seems to be, that the part most susceptible to magnetic action was not the balance, but the balance-spring.

I beg, therefore, to suggest the following, as rules to be adopted whenever there is reason to think that a chronometer is disturbed by magnetic action; and I wish to point out as a convenience attending the method, that it requires the use of only such apparatus as may be found in every ship:

1. Place a small compass upon the top of a large one, and determine by trial the distance to which it must be raised, in order that its directive power may be destroyed. In this state, measure the elevation of the small needle above the glass, or any other convenient part of the large compass: call this *a*.

2. Measure the elevation of the balance of the chronometer above the bottom of its box: call this *b*.

3. Place the chronometer box upon the large compass, the elevation of the bottom of the chronometer box above the glass of the compass being the excess of *a* above *b*. Then the balance will be at the same height as the small compass needle in the trial.

4. It will, perhaps, be found necessary to bring the chronometer a little nearer to the compass.

5. If a ship be passing through different magnetic latitudes, it will be necessary from time to time to repeat the trial, and to alter the adjustment accordingly.

6. The amount of discordance depending on magnetic action is a matter of no consequence whatever, and needs not to be ascertained beforehand. The same arrangement of the compass which corrects a small discordance will correct a large one, and will do no hurt to the chronometer, if it have no discordance whatever.

On long and short stroke Steam-Engines, and the Friction in Steam-Engines. By JOHN SEAWARD, *C. E.* [Communicated for the Civil Engineer and Architect's Journal.]

A popular notion has for a considerable time past prevailed, that a long-stroke engine is much superior to a short-stroke engine; and it will consequently be found that the practice of most, if not all engineers, is greatly regulated by this idea. On a very careful consideration, however, it does not appear that this alledged superiority can be satisfactorily proved. That a long-stroke engine in certain circumstances, may be much more advantageously employed than a short one, is undoubtedly true; but considering the steam-engine *per se*, that is, without reference to adventitious or extraneous circumstances, it would be difficult to show that the former has any advantage whatever over the latter.

For let a careful comparison be made of a long-stroke engine with a short-stroke engine; let there be two beam engines of thirty horses

power each, both equally well made, but the one having a stroke of 8 feet, while the stroke of the other is only 4 feet, the cylinder of the latter being double the area of that of the former; it being understood that both engines shall make the *same* number of revolutions per minute; the steam passages and valves to be of the same area and capacity; and the two engines in all other respects to be well proportioned, and made without any limitation as to space or weight.

Now as regards the mere mechanical effect of the moving power (*i. e.* of the steam) it is perfectly clear that it must be precisely the same in both engines, because the same volume of steam must produce the same mechanical effect whether it is let into a long narrow cylinder or into a short wide one; therefore, if there be found any difference in the efficient duty or economical working of these two engines, that difference must arise from circumstances quite unconnected with the mechanical effect of the steam power.

The only circumstances which really can make any essential difference in the efficient duty or economical working of these two engines are these:—1. The greater or smaller quantity of friction in the various parts of the machines.—2. The greater or lesser radiation of heat from the cylinders and passages.—3. The greater or smaller loss of steam by the clearance of the piston at the top and bottom of the cylinder.—4. The *inertia* and the impulse of the parts of the machine in motion on the surrounding air.

1. Of the *friction*. It will be found in the working of a well made engine of the proportions of the short-stroke engine under comparison, that more than four-fifths of the whole friction are due to the packings of the piston and air-pump bucket, and of the piston-rod and bucket-rod,* and less than one-fifth to the main gudgeons, the end gudgeons, the crank-pin, and other moving joints about the engine. But the friction of the piston-packing will vary as the circumference of the piston, multiplied into the distance which the piston travels. Now in the long-stroke engine, the piston, supposing it to be 30 inches diameter, will move eight feet, and the friction of the packing be therefore as 24; while in the short-stroke engine the piston will be about 42·4 inches diameter, will move only four feet, while the friction of the packing will be only as 17. In the same way it can be shown that the friction caused by the packing of the air-pump bucket of the piston-rod and of the bucket-rod is also respectively in the ratio of 24 to 17 in the two engines. With respect, again, to the friction due to the main and end gudgeons, &c. it is clear that it will be less in the long-stroke engine, because in the latter engine the force acting upon these parts will be one-half what it is in the short-stroke engine. Assuming, therefore, 100 to be the whole quantity of friction in an ordinary engine, then 80 of these parts in the short-stroke engine will be due to the piston, air-pump, bucket, &c. while in the long-stroke engines the friction of these parts will be as 113, that is $=\frac{24}{17}\times 80$; but the friction on the main and end gudgeons in the former engines will be as 20, and in the latter only 10, making

* The friction of the slide is not included, as that will obviously be the same in both engines. See remarks on friction, at the end.

the total friction in the short-stroke engine 100, and in the long-stroke engines 123, or one-fourth more.

2. The *radiation of heat* will be in proportion to the extent of surface; but the surface of the long-stroke cylinder is much greater than that of the short cylinder; whence it follows that the loss by radiation in the former must be greater than in the latter.

3. The *clearance of the piston* at the top and bottom of the cylinder, which will evidently be greater in the short-stroke engine than in the long-stroke engine. Because the area of piston in the former is double that of the latter, some persons would be disposed to say, that the loss by clearance in the former must be double what it is in the latter; but this is not quite certain, for it is not required to give so much clearance in a 4 feet stroke cylinder as it would be advisable to give in an 8 feet stroke cylinder, the reason of which is obviously that the spring and elasticity of the parts in the long-stroke engine, must be much greater than in the short-stroke engine, and that they must therefore require more clearance. However, it is probable that there would be more loss in the latter engine than in the former. The loss of steam by filling the passages and nozzles, as also by the radiation of heat from those parts, must evidently be the same in both engines.

4. *The inertia and impulse of the moving parts on the surrounding air.* The loss in a steam-engine occasioned by these two causes may not be very considerable; indeed, as regards what is called the *inertia* of matter in the moving parts, it is doubtful whether any such source of loss really exists: however if it does exist, it is clear, that the amount of loss must vary in proportion to the *momenta* of those parts of the machine which are in motion; but as the *momenta* must be as the mass of matter in motion multiplied by the velocity; and as these are evidently much greater in the long-stroke than in the short-stroke engines, (because the parts in the former are, if anything, of greater weight than in the latter, and also move at a double velocity) it follows that whatever loss may arise from the *inertia*, must be much greater (double ?) in the long-stroke engine than in the short-stroke engine. With regard to the loss occasioned by the impulse of the moving parts on the air, it must be admitted that in very slow motions it cannot be very important; nevertheless, with a material increase of velocity, this source of loss becomes serious: it varies as the extent of surface of the moving parts multiplied into the *square* of the velocity. It is tolerably manifest, however, that the surface of the moving parts in the long-stroke engine will be, if anything, greater than in the short-stroke engine, and that the velocity of the former will be twice that of the latter; therefore, the loss by impulse on the air, in the long-stroke engine, must be four times that in the short-stroke engine.

Beside the foregoing causes, it is doubtful whether there are any others that can produce any material difference in the efficient duty or economical working of a steam-engine; at least, none that can in any way influence the question now under consideration. In estimating, therefore, the advantages of the short and long-stroke engines, we have in favor of the former a diminution of loss occasioned by friction, by radiation, by *inertia*, and by impulse on the air; while on the other hand, we have in favor of the long-stroke engines a diminution of loss

in the clearance of the piston at the top and bottom of the cylinder. It may be difficult to strike an exact balance between these several sources of loss; but there can be no doubt that in a steam-engine the loss by friction is much greater than the loss by all the other causes before mentioned put together; and it is past dispute that the balance of loss as regards these causes is decidedly against the long-stroke engine. [The advantages offered by the short-stroke engine, as regards diminution of space and weight, although of vast importance, are not here adverted to, because they form no part of the immediate inquiry.]

It may be objected, that to select an engine with an 8 feet stroke and a cylinder of only 2½ feet diameter for comparison, is not a fair proceeding, because an engine of such proportions is unusual; and it may be also asked whether—if the principle be further extended by making the stroke only 2 feet, and again doubling the area of the piston—whether the advantage would still be in favor of the short-stroke engine? To this it may be answered, that although an engine of 8 feet stroke, and 2½ feet diameter of cylinder may be unusual in this country, it is not so in America: in that part of the world, many engines are employed of very nearly the above proportions, for purposes of steam navigation; and in which engines it is not unusual for the piston to travel at the rate of 300 or 400 feet per minute.

Again, as regards the carrying out of the principle by still farther reducing the length of stroke, say to 2 feet, and increasing the diameter of cylinder proportionately, say to 5 feet, there is no doubt whatever that such an engine would have precisely the same mechanical effect as either of the other two; but the balance of advantages would be against an engine of such proportions; because it would be verging to an extreme on one side as much as the 8 feet stroke engine may be thought extreme on the other side. It may however be safely affirmed, that the principle applies most powerfully to the case where the diameter of cylinder is the same as the length of stroke; because in that case the proportions are most favorable for the diminution of friction and of radiation, and offer the minimum of disadvantage under the several heads of loss above enumerated.

As it is manifest, therefore, that in all particulars which more immediately affect the beneficial employment or working of a steam-engine, the long stroke has no manifest superiority over the short stroke, it may appear strange that so decided a preference should have hitherto been given to the former by the generality of engineers. Perhaps this is chiefly to be attributed to the circumstance of the long stroke offering on most occasions greater convenience than a short stroke. Much may be due also to fashion. The earliest application of steam power was for the purpose of pumping water in the course of mining operations, and in this sort of work a good long stroke was found to be attended with considerable convenience and advantage. In blast engines, and many other of the earlier applications of steam power, the same result was manifest; the earlier habits and ideas of engineers were therefore naturally associated with long-stroke engines. Moreover, the earlier manufacturers of steam-engines had neither good machinery nor good workmen: they could neither depend upon the correctness of their proportions, nor upon the exactness of the workmanship; besides, timber

and other inefficient materials were formerly employed to a considerable extent in the construction of engines; from all which causes imperfections and irregularities were numerous in the earlier engines, and they were consequently very inefficient. As all these sources of imperfection and inefficiency operated much more extensively against short-stroke engines than against long, it is no wonder that the latter soon obtained a preference, and that the prejudice should still continue to exist, notwithstanding the same causes are no longer in operation. At the present day, with our good materials and workmanship, exact proportions and adjustments, a short-stroke engine will be found to work as accurately and as perfectly as a long-stroke engine.

There is one very important circumstance to be kept in view as regards long and short-stroke engines; which is, that whenever an engine of the latter description has hitherto been made, it has always been considered necessary to keep the cylinder nearly of the same diameter as in the long-stroke engine, and to cause the engine to make a greater number of revolutions in proportion to the shortness of the stroke, so that the piston in every case might travel at a nearly uniform speed of about 200 feet per minute. Now, to a short-stroke engine made on this plan there may undoubtedly be many objections. The more frequent alternation of the stroke; the greater loss of steam by the more frequent filling of the passages and nozzles, and the clearance at the top and bottom of the cylinder; the much greater angular motion of all the bearings and moving joints, thereby materially increasing friction and wear; are all circumstances tending to lessen the efficiency of a short-stroke engine made upon this plan. It is clear, however, that an engine made upon the principle herein before laid down is not open to the same objections.

And, as regard the speed of the piston in engines, whatever may be the length of stroke, being regulated to the uniform standard of about 200 feet per minute, there can be no valid reasons given for such rule; no one can prove that double the above speed, or only one-half that speed, might not be employed with equal or greater advantage. It is certain that in many steam-engines of the transatlantic world the pistons move at a speed of 300, 400, and even as much as 500 feet per minute; and no substantial reason can be alledged why such engines should not do good duty. Indeed, it may be safely affirmed, that whether the speed of an engine be 100 feet, 200 feet, or 300 feet per minute, it matters nothing; provided all the parts of the engines are well proportioned for the proposed speed, the efficient duty and economical use of the engine will be much the same: keeping this always in mind, that *the slow speed will be more favorable for the easy and pleasant working of the engine, and for durability.*

This question may, however, be asked: Since it is shown that the long stroke has no superiority over a short stroke, but on the contrary that the balance of advantage is rather in favor of the latter, is it intended to recommend the invariable adoption of a short-stroke engine, to the total exclusion of a long-stroke? By no means. All that is contended for is, that in every case a length of stroke should be adopted, whether long or short, that shall prove to be most convenient and best adapted to the object for which the engines are to be employed; and that an

engineer should not be fettered and cramped by any fallacious abstract notions; that what is termed a long-stroke engine must necessarily be more efficient than an engine with a short stroke; and that he should not therefore be obliged to sacrifice many other far more important considerations for the sake of obtaining in every case the longest possible stroke.

The application of steam power for the purpose of navigation has had such wonderful results, the character of the steam-engine has become so greatly changed, and the proportions so altered, that a marine engine of the present day, and a land engine of former times, can scarcely be recognized as belonging to the same class of machines. The length of stroke of marine engines is probably not more than half what used formerly to be given to engines of similar power for mining and manufacturing purposes; but still, no one can say that this departure from old rules and maxims has been attended with any disadvantage; on the contrary, it can be shown to have been most beneficial and glorious in its results; and if a still further departure from old established notions can be proved advantageous for steam navigation, we can have no reason whatever to regret the change.

There is no question that the ordinary beam engine, as employed in steam vessels, has proved most efficient, and that in its application it has been productive of vast benefit. If, however, by a modification of the existing steam-engines, these benefits can be still further augmented, and that in an eminent degree, no consideration ought to stand in the way of the proposed improvements. The great and paramount objects to be aimed at in the construction of steam-engines for navigation are the following, viz. the greatest saving of fuel, the greatest saving of space, the greatest saving of weight, and the greatest durability of the machinery. The more eminently the marine engine shall combine the above important qualities, the more nearly will it have arrived at perfection; and much as may be advanced in favor of the beam engines generally used for marine purposes, it cannot be considered presumptuous to declare that the system of engines employed in the "Cyclops" and "Gorgon" frigates is far superior in all the qualities before enumerated.

It only remains to be stated, that the real question is not whether the stroke of an engine shall be 8 feet or 4 feet, but relates to a difference of stroke, of probably from 7 to 6 feet: that is, whether the reducing of the stroke of a 200 horse engine *one foot*, with a proportionate increase of diameter in the cylinder, can be attended with such injury and inefficiency as shall wholly neutralize or outweigh all the important advantages of the Gorgon engines.

In conclusion, it should be observed that as regards the ordinary beam engines, there are many circumstances of convenience which render it advisable to make the stroke as long as practicable, *i. e.* the adopting a tall narrow cylinder instead of a short and wide cylinder; for in the arrangement of the ordinary beam engine for marine purposes it is evident that a considerable space lengthways is required for conveniently placing the slide-jackets and passages, the condenser, the hot-well, and the air-pump: this necessarily causes a great elongation of the side levers or beams. There is, therefore, much local convenience in

making the stroke long, and thereby having a tall narrow cylinder instead of a short wide one, less strain is thrown upon the beams; the beams become more close and compact, and afford more space for a passage between and on the off sides of the pair of engines: the cross-heads and fork-heads become shorter, and have much less strain thrown upon them. These are all very important considerations, which clearly indicate the convenience and possible advantage of having as long a stroke as possible in the ordinary beam engine. But in the Gorgon engine none of these considerations have any influence whatever; here there are neither beams nor cross-heads; we can increase the diameter of the cylinder to almost any extent without any local inconvenience whatever.

We shall conclude these observations with the remark, that as it cannot be proved that there is any superiority in a long-stroke engine over a short-stroke engine, and as it is also evident that there is no disadvantage whatever in employing a short connecting rod, it is therefore clear that the two objections are decidedly absurd and groundless.

OF THE FRICTION IN STEAM-ENGINES.

In the preceding pages we have offered an investigation of the comparative merits of the Gorgon, and of the common beam engine; in the course of our remarks it became necessary to advert to the important subject of friction; it will not therefore be deemed misplaced to add a few general remarks upon the nature of the friction which occurs in a steam-engine of the usual construction.

To attempt anything like a correct estimate of the absolute quantity of friction in an engine would, we conceive, be very fallacious, because there are so many circumstances which affect the quantity of friction, which are quite beyond the reach of calculation; as, for example, the uncertain degree of tightness to which the several bearings or packing may be screwed down; the state of the rubbing surfaces, as to smoothness, polish, or roughness; the perfect or imperfect state of the lubrication, &c.; all of which are circumstances which have a vast influence on the quantity of friction in a steam-engine. From observations which the writer has made, he is induced to believe, that in a well-made engine, in good working condition, the total amount of friction does not exceed five or six per cent on the whole power of the engine; but that with no very great change of circumstances this quantity may be increased readily to as much as 10 or 12 per cent.

It happens, however, that in the preceding investigation the consideration of the absolute quantity of friction in the engine is not required; all that is wanted is an estimation of the relative proportions of friction which are due to the several parts of the engines; now this sort of estimation is not very difficult: at all events we can arrive at an approximation sufficiently near for practical purposes.

For, if we assume that all the moving or rubbing surfaces throughout the engine are equally smooth; that all the packings and bearings are uniformly secured down; that all parts are well lubricated; then the comparative quantity of friction in the several parts will be, as the area of one of the rubbing surfaces multiplied into the distance which it

moves up on the other rubbing surface. We obtain thus the following rules :—

1. For the relative quantity of friction due to the piston, multiply the circumference of the piston by the depth of the packing, and by the distance which the piston moves up and down by the cylinder.

2. For the friction of the main shaft bearings, multiply the square of the circumference by the length of the bearing.

3. For the friction of those bearings which do not revolve entirely round, but oscillate backwards and forwards as the beam, gudgeons, &c. multiply the area of the bearing into the angular distance moved backwards and forwards during one revolution of the engine, &c.

4. It should be observed, however, that when one of the two rubbing surfaces is hemp packing, the amount of friction will be at least double what it will be when both surfaces are metal.

5. Furthermore, there are certain bearings which receive the direct strain of the engine, while others do not. The following receive the direct strain, viz. the crank-pin, the fork-head gudgeons, the main gudgeons, the upper and lower bearings of the side rods; now the quantity of friction upon these several bearings will be considerably more than that which is simply due to the tightening down of the bearings, as before assumed; it is difficult to say what may be the increase of the friction from this cause, but it will be safe to assume that the friction on these bearings will be three times greater than what is due to the other bearings.

Upon the foregoing principles, therefore, is calculated the following table of the comparative friction of the different parts of an engine, having a 40 inch cylinder, a 3½ feet stroke, and furnished with the common D slide.

TABLE OF COMPARATIVE FRICTION OF THE MOVING PARTS OF A STEAM ENGINE.

2 (Rule IV.)		
125½ in. circumference, 4 in. deep, 84 in. distance,	84·336	Piston, with hemp packing 4 in. deep, moving a distance of 84 inches.
2		
13 in. circumference, 4½ in. deep, 84 in. distance,	9·828	Piston rod, hemp packing 4½ in. deep, moving 84 inches.
2		
82 in. circumference, 3 in. deep, 42 in. distance,	20·262	Air-pump bucket, hemp packing 3 in. deep, and moving 42 inches.
2		
8 in. circumference, 3½ in. deep, 42 in. distance,	2·352	Bucket rod, hemp packed, 3½ in. deep, moving 42 inches.
2·2		
12 in. circumference, 3 in. deep, 42 in. distance,	6·048	Two plunger poles, with hemp packing 3 inches deep, moving 42 inches.

15 in. wide, 8 in. 2 faces deep, 14 in. distance,		Flat face 1·680	The slide face metal and metal back, hemp packed, 6 inches at top, 6 inches at bottom, moving 7 inches each way.
2 24 in. circumference, 12 in. deep, 14 in. distance,	10·059	Back, hemp 8·064	
2 $4\frac{1}{2}$ in. circumference, $2\frac{1}{2}$ in. deep, 14 in. distance,		Slide rod 315	
2 25 in. circumference, 9 in. length, 25 in. distance,	11·250	The two main shaft bearings moving entirely round, metal and metal.	
18 in. circumference, 9 in. deep, 18 in. distance,	2·268	The bearing at outer end of paddle shaft.	
3 (Rule V.) $15\frac{1}{2}$ in. circumference, 6 in. long, $15\frac{1}{2}$ in. distance,	4·323	Crank pin, moving entirely round, and receiving the direct strain of the engine.	
3·2— 10 in. circumference, $3\frac{1}{2}$ in. long, $2\frac{1}{2}$ in. distance,	·525	The 2 fork-head joints moving at an angle of 45° each way, but receiving direct strain of engine.	
3·2— 10 in. circumference, $3\frac{1}{2}$ in. long, $2\frac{1}{2}$ in. distance,	·525	Two lower bearings of side-rods same as fork-head joints.	
3·2— 18 in. circumference, 7 in. long, 9 in. distance,	6·804	The two main gudgeons receiving the strain of the engines, and moving 90° each way.	
45 in. circumference, $13\frac{1}{4}$ in. deep, 45 in. distance,	3·543	Eccentric ring moving quite round	
	1·000	Sundry small joints.	
	163·123		

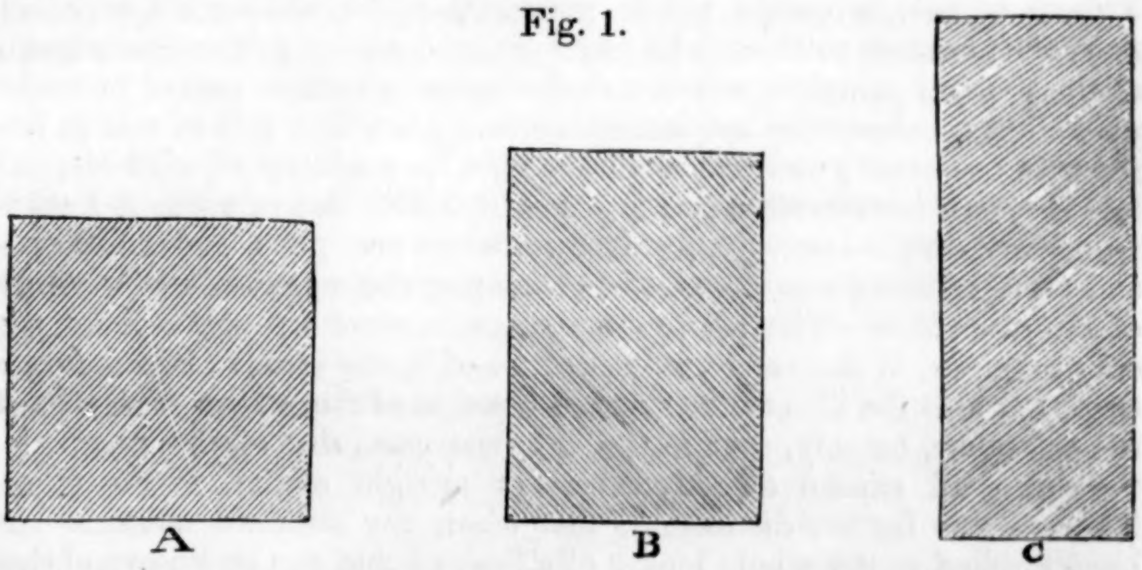
Therefore, if it be assumed that the total quantity of friction in a steam engine is as 163·123, then will the relative quantity of friction in the several parts be nearly as is represented by the numbers in the preceding table.

PROPORTIONS OF BEAUTY IN SIMPLE FIGURES.

[CONTINUED FROM PAGE 48.]

It will be borne in mind that we stated the approximate proportion of the length and breadth of the rectangle of beauty to be as 10 to 7. These do not express the proportion exactly; for 10 is the diagonal of a square, and 7 is the side of the same; and the diagonal and side of a square are incommensurables, and cannot be exactly expressed by any numbers whatsoever. It is to be understood that the 10 and 7 may express any measures whatsoever, or any fractional parts of named measures; and that, whatever the unit or standard of measure in these two numbers may be, it must be the same in both, and its meaning must be the length of some line, which line may, however, as we have said, be of any length. If we multiply 7 and 10 together, 70, their product, will express seventy squares, having all the sides equal to the measuring unit. Farther, every rectangle, whatever may be its proportions, in which the product of the length and breadth amounts to 70, must have the same area or superficial content as the rectangle of beauty, of which 10 and 7 are the length and the breadth. In illustration of this, we introduce the following simple diagram:

Fig. 1.



In this example, A is a square, B the rectangle of beauty, and C another rectangle, of which the length is 14 and the breadth 5. These three figures contain very nearly equal areas, and those of B and C are exactly equal. That of the square, A, differs a little, though but a very little, from the other two; because the side of the square is not commensurable with either the length or the breadth of the rectangle of beauty; and thus, if we had taken an exact square for the figure A, the other figures would have been incommensurable with it. Therefore, the approximate proportions of the rectangle of beauty were assumed; and the square root of 70, their product, which is 8·37+, taken as the side of the square. The dimensions of the rectangle C were taken at random; and the assumed area, 70, divided by the assumed length, 14, gave 5 as the breadth. This third rectangle is made up of four rectangles of beauty, having their length 5, and their breadth $3\frac{1}{2}$; and four such rectangles would also of course be obtained by bisecting the rect-

angle B by parallels in the direction of its length and of its breadth. Simple inspection of the figures will show that there is the greatest apparent stability, but at the same time an expression of heaviness in the square, A; and that there is an instability in C as compared with the others; and it is obvious that this air of instability would become greater and greater as the figure were lengthened and narrowed, until its breadth and area vanished into an interminable straight line.

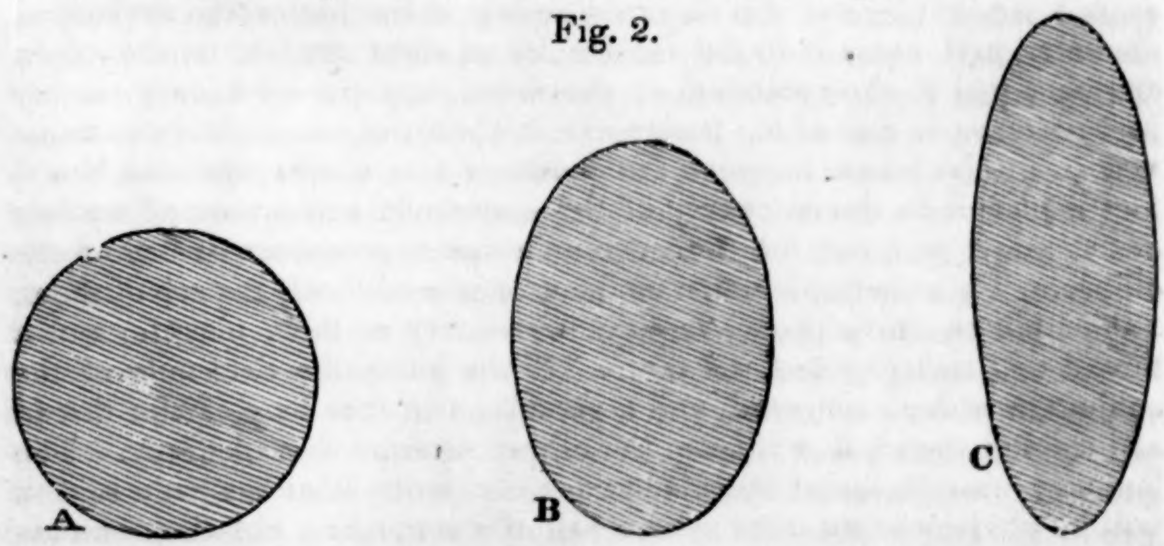
The fact of a rectangle vanishing into an *interminable* straight line is a property worth bearing in mind; and it applies to every figure of which the shape is altered by increasing one dimension, and diminishing the cross or conjugate one, preserving the same area, until the cross dimension vanishes, and that area becomes 0.

The general deduction from this, which though tacitly admitted is not always understood, is that no length of line can be equal to any area however small; for two squares, one with the millionth part of an inch for its side, and another with a million of miles for the same, would both ultimately vanish into interminable straight lines, and therefore be equal to each other in the instant of vanishing. In like manner it might be shown that two cubes, or two solids of any kind, how different soever they might be in their contents, would both vanish into interminable surfaces, and thus be equal to each other in the instant of vanishing. This, however, is foreign to our present purpose, although it may not be wholly useless to those who have not studied the subject—inasmuch as the general principle which it shows is that a surface cannot be made up of lines, unless they are interminable ones, which it is of course impossible to obtain; and that a solid cannot be made up of surfaces, unless they are interminable and impossible. The idea of a line is a comparatively simple one—the distance between one point and another—and there cannot be two modes of estimating the magnitude or quantity of the same line. The idea of a surface is more complex; for it not only involves, in the very simplest mode of it, the ideas of two separate lines, but also the idea of the relative position of those lines with regard to each other, namely, that in the simplest case, that of the rectangle, the one shall extend directly across, or at right angles, to the other. There is this further distinction, that when any standard measure has been applied to the whole length of a line, all that can be known of that line as a magnitude or quantity is discovered; but that, after the length and breadth of a rectangle have been accurately measured as lines, we are in total ignorance of the value—the area or content of the same rectangle as a surface—until we have performed an operation which has nothing to do with measuring; that is, we multiply the length and breadth, in order to find the area. This is an arithmetical operation in the mode of its performance, but the result of it is quite different from any arithmetical result, inasmuch as the product is a quantity totally different from both of the factors whose multiplication furnishes that product. In the case of a solid, even of the most simple solid—a cube or rectangular prism—there are three measurements necessary, namely, those of the length, the breadth, and the thickness; and the lines representing these must have one definite relation, that is, each of them must be at right angles to the other two. When they are accurately measured by the same standard, and all three are multiplied together,

which requires two operations in multiplying, the product of the three gives the content of the solid in cubes, the edge of which is equal to the unit of the lineal measure in which the three dimensions were taken.

But although areas are found by multiplying length and breadth, and solidities by multiplying length, breadth, and thickness, yet there is something more in these operations than there is in multiplication arithmetically considered. The product of a common multiplication is of the same kind with one of the factors, and expresses as many times that factor as the number 1 is contained in the other factor; but when length and breadth are multiplied, the product is neither so many times the length nor so many times the breadth, but a quantity in its nature totally different from both; and its species depends, not upon the values of the length and breadth as factors, but upon the fact of their standing in a particular relation to each other—that is, being at right angles. So also, in the case of the value of a solid, expressed by the multiplication of the length and breadth, and then by the multiplication of their product by the thickness, it is not the mere fact of those factors being lines of certain definite lengths which makes the product of the three represent the content of a solid; it is the fact of their being so related to each other that every one of them is at right angles to both of the other two. When these principles present themselves singly, they are easily understood; but there are complicated cases in which they are mixed up with other elements; and, when such cases occur, there is always danger of being misled, and that on account of the very simplicity of the principles themselves. Indeed, there is no subject to which less attention is paid than the analysis of those relations, distinct altogether from the mere consideration of quantity, which form the essence of geometry; and for the want of due knowledge of which most of the geometrical errors of surveyors, engineers and architects are committed. This is our plea of justification for what to some may seem an interpolation; and as such subjects introduced under their own specific names would not be read, we may, as occasion offers, introduce slight notices of them.

Fig. 2.



In these three diagrams we have endeavored to give the same specimens of a curvilineal figure as we previously did of a straight-lined one; and, as we did in the case of those, we have here given the same length and breadth as in the rectangles, and the same area or surface in each of the figures. A is a circle, which, if applied to the square in the

former diagram, would touch the middle of each of the four sides; and B and C are ellipses, which, if applied to the corresponding rectangles in the former diagrams, would touch them in the middle of the length of each side, and the middle of the breadth of each end. The circle and ellipse are not commensurable with the square and the rectangle in their surfaces, or in their bounding lines; for a curve and a straight line are not quantities of the same kind, and neither of them can be exactly expressed in terms of the other; but approximations sufficiently near for all practical purposes may be obtained. Thus, for instance, if each side of a square is counted 1, and the perimeter consequently 4, the circumference of the circle inscribed in that square and touching each of its four sides in the middle will be 3·14159. The area of the square in this case will be 1; and if we divide the circumference of the circle by 4, the approximate area of that figure will be ·7854 very nearly, that is, a little more than three-fourths of the area of the square. The same proportion also holds between the area and the surface of every ellipse, and those of the rectangle which that ellipse touches in the middle of both its sides and both its ends. Therefore, the three figures in the second diagram which have their diameters equal to the sides of the square and the rectangles in the first diagram, have all equal areas, and their bounding lines increase in quantity with the increase of the length and diminution of the breadth, in exactly the same ratio as the rectangles. The circle which answers to the square has but one centre, and all its diameters are equal to each other, and also to the side of the square which it touches internally in four points. The ellipses, on the other hand, have two centres; and the property of the ellipse is such that the sum of the distances of every point in the circumference from the two centres is always the same, and equal to the transverse or longest diameter. Hence, independently of other considerations, those who are not furnished with a trammel or other instrument for describing ellipses have a very easy way of drawing these figures of any form and dimensions that may be necessary. All that is required for this purpose is, to draw a straight line of the required length of the transverse or longest diameter, and cross it in the middle by another straight line at right angles, equal to the conjugate or shortest diameter, and having exactly its half on each side of the transverse. This being done, half the transverse is to be taken between the points of the compasses, and if one foot is placed on the extremity of the conjugate, and an arc of a circle described, it will cut the transverse in the two centres or foci of the ellipse. These being found, a pin may be placed firmly in each of them, a third pin similarly placed in either extremity of the conjugate, and a thread tied tightly round the three. If the pin in the extremity of the conjugate is then removed, and a pencil put in the loop of the thread and carried round, it will trace the ellipse with perfect accuracy. The foci may also be found by calculation; for, from what has been said, it will be obvious to the reader that half the conjugate, and the eccentricity or distance of either focus from the centre of the transverse, are the two sides including the right angle, in a right-angled triangle, and that the semi-transverse is the hypothenuse, or side subtending the right angle. Therefore, if the square of half the conjugate is subtracted from the square of half the transverse, the square root of the remainder

will give the eccentricity; and this, set off both ways from the middle of the transverse, will give the two foci, from which the ellipse may be described as before stated.

So much for the mode of describing the ellipse; and, from what has been said, it will be seen that an ellipse is nothing but a circle presented obliquely to the view, and having its transverse diameter longer in proportion to its conjugate in proportion as it is more oblique. If the area is the same, as we have represented it in the above figures, there is a countless number of ellipses between the circle and the straight line into which they ultimately vanish when the conjugate diameter becomes 0, and the transverse interminable. The circle, or primary figure, is, like the square among rectangles, expressive of strength, but not of beauty; and the interminable straight line into which the ellipses finally vanish is expressive of perfect instability, in which there can be no beauty, any more than in that which represents mere strength. We have to seek the ellipse of beauty somewhere between those limits; and the eye itself, upon seeing them when described, will instantly fix upon that which is marked B in the diagram, and which answers to the rectangle of beauty in the diagram first given.

A circle or an ellipse, or some arc either of the one or of the other, is the figure usually adopted in the construction of arches, whether for ornament or for use, or in that perfection of the constructive art, in which utility is rendered beautiful, and beauty useful; and, if such an arch is perfect of its kind, the semicircle or the semi-ellipse is the most perfect, inasmuch as no other portion of either curve will pass into the straight lines of the abutments or piers without an angular transfer from the curve to the straight line, which is in all cases a deformity. The semicircle is the strongest arch which can be formed of any of those curves; but it is far from being the most beautiful, for the sight of it is as offensive to one's higher feelings as that of a round bullet head upon a human being, which completely spoils the dignity of the figure, how perfectly symmetrical soever it may be in all its other parts. For this reason, no engineer or architect of good taste will ever introduce a semicircular arch into any structure having the slightest pretensions to elegance. The perfect contrast to the circle is the straight lintel, such as was used by the ancients, who were acquainted with scarcely any principle of stability except the strength and mass of the material which they employed; and this, notwithstanding the huge blocks of stone which they made use of, confined them within narrow limits in the height of their buildings, unless the apertures of those buildings were disproportionately small. The beautiful arch must be sought for between the semicircle and the straight lintel; and it must be lower than the first, and higher than the second. A semi-ellipse, standing in its conjugate diameter, makes a most unsightly arch; for the whole opening which it tops always looks as if the sides of it were squeezed together by some unnatural pressure. A semi-ellipse, standing on its transverse diameter is, therefore, the proper curve in which to seek for the arch of beauty; and, upon comparing a number together, it will be found that the proportions of the ellipse marked B furnish a more graceful curve than any others. When this is made use of, the proportions are, 10 for the span of the arch, and $3\frac{1}{2}$ for the height of the crown above the line drawn

from the springing at the one side to that on the other. If this arch be used for a purpose in which the ornamental predominates, as for a gateway, a door, or a window, then the most harmonious application of abutments to it is obtained by applying to it the rectangle of beauty standing on its shorter side, in the case of a window or door of a house; and on its longer side, in the case of a carriage gate. Thus, for instance, if the straight sides of an arched door or window are made ten feet high, and seven feet apart, and an elliptic arch of two and a half feet rise is turned over them, the outline of the aperture will be more elegant than if it had any other proportions. So, also, if the piers of a gate are seven feet high, ten feet apart, and have a semi-ellipse of three and a half feet rise turned over them, the appearance of the opening will also be perfect in its way, and though not so elegant as the former, it will have a greater expression of stability taken as a whole. There are many other applications of the relation of 1 to the square root of $\frac{1}{2}$, which will occur to any one who has studied forms sufficiently for giving elegance to any structure he may be required to erect; but what we have stated must suffice in the meantime, although we may be permitted to add, that this first and simplest element of beauty is too generally neglected. London Surveyor, &c.

A series of Experiments made with Locomotive Engines, on the Hull and Selby Railway.

On Tuesday, the 10th instant, a course of five days' experiments commenced with the engines of the above railway, originating through the following circumstances:

About the commencement of the present year, six engines somewhat similar to those on the Leeds and Selby line, were in greater or less state of forwardness for the Hull and Selby Railway, at the works of Messrs. Fenton, Murray, and Jackson, of this town, when the Hull and Selby Railway Company resolved to have six other engines, on the most approved construction which experience up to that period could produce, from the previous working of locomotives on the various railways. Four objects were particularly kept in view, namely, *safety*, *simplicity*, *accessibility* of the various parts, and *economy*, the whole combining general *efficacy* and *durability* of the engine throughout.

The first object is secured by giving a more extended *base* for the action of the springs in supporting the weight of the engine, being about six and a half by eleven feet, whereby a remarkably steady motion is secured at thirty miles per hour. It is not at all a matter of surprise that the four wheel engines of several railways now in use should now and then go off the road, and in an instant, when it is recollected the extreme base of these springs for supporting the engine is only about three and three quarters by about six feet; hence their rocking, serpentine and pitching motion, which, without any other cause than a slight increase of speed, literally lifts the flanges of the wheels above the surface of the rails, and in three or four seconds the engine is turned end for end, upset in the act, and the train with it; whilst the stability of the engine is effectually secured through an extended base upon the

front and hind wheels. By means of a new combination the best properties of the four-wheeled engines are also completely applied, by resting the weight on the crank-shaft immediately within the wheels, which experience has for years proved to be the least likely to injure it, and thereby avoid the alarming accidents which have so often taken place by the breaking of the shaft, through placing the weight on bearings outside of the wheels; the centre of the engine being a sort of neutral axis, there is very little power over its motion in that part, and this advantage, by placing the weight on the crank inside the wheels, is in consequence got without a sacrifice of stability.

2ndly. In addition to the safety and simplicity of having only *two* inner frames, instead of three or four, with as many bearings on the crank-shaft, the space under the boiler is still further stripped of machinery by a new valve motion, which gives a high degree of openness and facility of access so desirable in examination, cleaning, &c. of the working parts.

3rdly. The steam being used expansively by the valve motion above alluded to, a great saving in fuel is effected, as will be seen on examining the results of the experiments; and as the excessive wear and tear of locomotive boilers arise from intense heat, it is not improbable this decided step towards removing the cause will prevent the effect, namely, the rapid destruction of the boiler. The action of this valve motion is perfectly smooth, being worked by eccentrics (which are also of an improved construction,) and any quantity of steam from 25 to 90 per cent. on the stroke can be admitted into the cylinders with the most ready and complete control, at any speed the engine may be going; if a high wind or an incline oppose the progress of the engine, a greater quantity of steam is admitted; if wind or gradients be favorable, the steam is still admitted at full pressure into the cylinders, but shut off at an earlier period, propelling the pistons the remainder of the stroke by its elastic force, similar to driving a time-piece by the uncoiling of the mainspring.

Lastly. A combination of dimensions and proportions have been gleaned from the best results of locomotive engines of various constructions, and in use in different parts of the country. The driving wheels are 6 feet diameter, length of the stroke 2 feet, diameter of cylinders 12 inches, inside dimensions of fire-box 3 by 3½ feet, tubes 94 in number by 9½ feet long and 2 inches diameter. The general diminution of machinery in the construction has given room for ample dimensions in the principal working parts, and thus the whole arrangement has a close bearing on *safety*, *simplicity*, *accessibility* and *economy*.

Circumstances led to those engines being ordered of Messrs. Shepherd and Todd, Railway Foundry, of this town. The Hull and Selby line was opened with the engines of the former order, but the public and the company being so much annoyed by hot cinders from their chimneys, burning whatever they lighted upon, and rapidly destroying the smoke boxes themselves, three of those engines were altered, and succeeded to a considerable extent in diminishing the nuisance, whilst the engines performed better, and with less fuel. That fact, however, being questioned, and two engines of the *improved* construction having got to work, Mr. John Gray, the engineer of the locomotive depart-

ment, and patentee of the improved engines, urgently requested a most rigorous and simultaneous trial of the different engines, and to be witnessed for the parties concerned by persons above suspicion. Mr. J. Miller and Mr. T. Lindsley represented Messrs. Fenton, Murray, and Jackson; Mr. J. Craven and Mr. J. Barrons represented Messrs. Shepherd and Todd; and Messrs. E. Fletcher, W. B. Bray, J. G. Lynde, jun., J. Farnell and J. Gray, were the representatives of the Hull and Selby Railway Company. The arrangements for the experiments were, that the gross load should include engine, tender, carriages, and everything in the train.

The steam was got up in the respective engines to the pressure of from 56 to 66 lbs. per square inch; the fires filled to a certain level at the starting in the morning, and filled to the same level on finishing the last trip at night. The pressure of the steam at starting was generally up to 66 lbs., and was at about half that pressure at the end of each trip. There were *fifty* experimental trips made in all, namely, 24 trips with the *Collingwood*, *Andrew Marvel*, and *Wellington*, the unaltered engines of Messrs. Fenton, Murray, and Jackson. Their average gross load was 53.4 tons, or 1656 tons, over one mile: consumption of coke 1013 lbs., or 0.611 lbs. per ton per mile; water 6500 lbs., or 3.90 lbs. per ton per mile. There were 10 trips made with the other three engines of Messrs. Fenton, Murray, and Jackson, which were altered at Hull, namely, the *Exley*, *Kingston*, and *Selby*. Their average load was 49.16 tons, or 1524 tons over one mile; consumption of coke 635 lbs., or 0.416 lbs. per ton per mile; water 4264 lbs., or 2.79 lbs. per ton per mile.

The *patent* engines made by Messrs. Shepherd and Todd, viz., the *Star* and *Vesta*, made 16 trips, and their average loads, &c., were 55.4 tons, or 1718 tons over one mile; coke consumed, 465 lbs., or 0.271 lbs. per ton per mile; water 2874 gals., or 1.62 lbs. per ton per mile. The average gross load of all the 50 trips is 53.2 tons, or 1649.4 tons over one mile, and taking that as a standard load, the consumption of fuel and water performing exactly equal quantities of work, is represented in the following table:

CLASS OF ENGINES.	Load in tons conveyed over 1 mile.	Elsecar coke used per trip of 31 miles in lbs.	Coke used per mile in lbs.	Coke used per ton per mile in lbs.	Water used per trip of 31 miles in lbs.	Water per mile in lbs.	Water per ton per mile in lbs.
Patent	1649.4	446.98	14.41	0.271	2672	86.19	1.62
Altered ...	1649.4	686.15	22.13	0.416	4601.8	148.43	2.79
Unaltered .	1649.4	1007.78	32.59	0.611	6432.6	207.5	3.90

The financial annual result of the three classes of engines for coke and boilers, with such a traffic as that of the Hull and Selby line, will be about— £4500 for the unaltered engines.
£3250 for the altered engines; and about
£2000 for the patent engines.

In conclusion, it is deserving of remark, that *all* the attesting witnesses expressed themselves highly satisfied with the manner in which the experiments had been conducted, and with the facilities which the company so readily granted to enable them to come at correct results. Probably no experiments were ever made under similar circumstances where the parties concerned displayed greater independence, impartiality, and good feeling, than on the present occasion. *Leeds Mercury.*

MISCELLANEOUS.

Pacific Steam Navigation Company.—The boast of Mr. Canning, that he had called the new world into existence to settle the balance of the old, was considered rather as the happy figure of the epigrammatist, than the profound conviction of the statesman. And when, after the expiration of twenty years of independence, we behold the South American States, relatively to the rest of the world, in precisely the same position of political insignificance, there certainly is some ground for the conclusion. But, if we consider how important an element of human civilization and national power are means of quick and easy communication between distant localities, and, on the other hand, how wofully deficient the whole of Southern America has hitherto been and is in these respects, the solution of the problem is not very difficult, and it at once becomes obvious, that if the views of Mr. Canning be still not realized, it is because their fulfilment must be sought in the cultivation of science and art, rather than in political institutions.

From the prevalent calms on the western coast, and the physical obstacles of the country to the formation of roads, these states are, as regards intercommunication, but so many "*disjecta membra.*" The introduction of steam navigation will therefore be of incalculable advantage, and would do more in twelve months towards placing them in their true political position—leaving out of sight the vast moral and social gain at the same time accruing, than years might effect under the existing system. All must therefore hail with sincere gratification the success of Mr. Wheelwright's labors—a gentleman who, from many years residence in South America, is fully aware of the source of these evils, and, at the same time, alive to their remedy; accordingly, by indefatigable exertions, he has at length succeeded in establishing a company in London, for the specific object of navigating the Pacific by steam, with a guaranty from the several governments of Peru, Chili, Equador, &c., of an exclusive privilege of action, and an exemption from port and other duties, for the space of ten years.

The plans and operations of the company are now so far matured that we were enabled, one day during the last week, to visit their two first vessels, lying in the East India docks, and which are nearly ready for sea; both, we can bear testimony, do infinite credit to the spirit and taste of the management. They are very superior craft of their class, (being each of about 700 tons burden.) The equipments and accommodations are of an ample and elegant description. The main cabins and saloon, which are on the upper deck, are really superb; the whole subservient to that free and perfect ventilation, so essential to the health and comfort in a tropical climate. Altogether they are fine specimens of our naval architecture, and of the skill of the builders, Messrs. Young and Curling, of Limehouse, who, we understand, have orders for laying down a third vessel for the same station. The engines of each, built by Messrs. Miller and Ravenhill, are two of 90-horse power, and for compactness, simplicity, and strength, are equal to any we have ever seen. We must not omit to mention an important adaptation of the boat paddle-box of Captain Smith, which we should wish to see

more generally adopted. It is one of the most admirable economizers of space we are aware of.

We are happy to learn that there is a probability of abundance of coal being found along many parts of the coast, requiring only the sanction of the local governments to be worked.

Upon the whole, from the spirit and respectability of the company, we are decidedly induced to augur well of the undertaking, which, whether we consider the great and permanent benefits naturally resulting from increased facilities of intercourse to the commercial relations of Great Britain with the new world, or the eventual destinies of its infant states, is second neither in importance nor interest to any—even in this age of enterprise. London Surveyor, &c.

Roman Antiquities.—By digging in a cellar at Strasburgh, there have been lately discovered Roman slabs, of a very fine red earth, some of about 16 inches square, and others of about 8 inches; all bearing the inscription, "Eight Augustan legion." There were also discovered fragments of a magnificent Etruscan vase, 3 feet in height, with bas-reliefs of admirable workmanship, and one of about half the size, containing ashes. Farther excavations are being carried on, and the result has been, that a vault supported by pilasters has been found, and other valuable evidences will no doubt be brought to light.

The Tomb of Napoleon.—The model of the tomb of Napoleon, now erecting by M. Marochetti, under the dome of the Invalids, is composed of a large base, surrounded by columns and bas-reliefs, supporting at the four corners as many statues, one holding the globe, another the sceptre, a third the hand of justice, and the last the imperial crown. Upon this is another base, two-thirds the width and one-half the height of the first, also decorated with bas-reliefs, and having at each angle an eagle with expanded wings. This, again, is surmounted by a pedestal eight feet high, decorated with bas-reliefs, and having in the centre the word Napoleon, upon which is an equestrian statue of the Emperor, wearing the imperial mantle, and having the brows crowned with laurel. The left hand holds the bridle, while the right carries the sceptre of the empire, raised to the height of the head. The two bases and pedestal, which rise to the height of nearly 40 feet, are of wood, and the statues of carton. The equestrian statue is 15 feet high, the eagle 6, and the other ornaments in proportion. The effect is exceedingly grand, and worthy of the subject. The execution is expected to occupy M. Marochetti three years.

Rock Crystal Spun.—M. Gaudin sent to the Academy of Sciences, at the last (April) session, specimens of rock crystal, which he had succeeded in melting and drawing out into threads several feet in length, with the greatest ease. One of these can be wound into a skein, and the other wound round the finger. M. Gaudin has found also, that melted rock crystal moulds easily by pressure, and that it is very volatile at a temperature a little above its melting point. Alumina acts very differently from silica; it is always perfectly fluid, or crystalized, and cannot be brought to a state of viscosity; while viscosity, separate from

all tendency to crystalization, is the permanent condition of silica under the oxygen blow-pipe. Alumina is much less volatile than silica; it often, however, undergoes ebullition. In a more recent essay, M. Gaudin has tried the temper and relations of rock crystal, which has afforded unexpected results. If a drop of melted crystal fall into water, far from cracking and flying to pieces, it remains limpid, and furnishes good lenses for the microscope. When struck by a hammer, the instrument rebounds, and the lump will sink into a brick rather than break: its tenacity is such, that pieces can be detached only as splinters. It resembles steel in elasticity and tenacity. Silicious compounds act nearly in the same way as rock crystal. The sandstone of the pavements spins off like it, with this difference, that its threads, instead of being limpid, are a pure white, nacreous, silky, and chatoyant, in a singular degree, so that they might be mistaken for silk; and the globules, to a certain degree, have the aspect of fine pearls. There is no doubt that in this way successful means will be employed in producing imitations which will be preferred to natural pearls, since they will possess the hardness of annealed rock crystal, instead of that of a calcareous compound. The emerald threads perfectly well, and its threads, which scratch rock crystal, are also more tenacious than crystal threads.

Jour. de Pharm.

Maximum Density of Water.—The temperature at which water assumes its greatest density has been fixed by Muncke, at 39°·05; by Stampfer, at 38°·82; by Hällstroem, at 39°·25; more lately Despretz has fixed this point at 39°·20; the mean of all these is 39°·08: so that perhaps 39°, the number obtained by Crichton, may be taken as the true temperature.

Coal on the Black Sea.—A coal mine is said to have been discovered at Penderaclia, one of the finest ports on the Black Sea, belonging to the Turkish empire. A steamer was sent from Constantinople, in order to examine the locality, and bring back some specimens of the coal, which it did, besides using the same on her return for the purpose of heating her boilers.

Island of Formosa.—From some extracts from a Chinese work read at the French Academy, by M. S. Julien, it appears that there are two volcanoes towards the eastern part of this island; a boiling spring from which an inflammable gas issues—the boiling appearance being probably produced by the evolution of the gas; a muddy river and springs; a mountain of sulphur, and a bridge of iron wire, which crosses the river Khichoui-Khi (rapid river.)

Paint for Metallic Surfaces.—The scaling off of paint from metallic surfaces arises generally from the contraction of the paint, leaving minute cracks through which moisture penetrates to the surface, and insinuates itself below the scale: this may be greatly palliated, by heating the paint before applying it, and by melting in it a small portion of beeswax, which prevents the shrinkage and the formation of cracks. A paint is much used in India for ornamenting work which is to be exposed to heat and moisture—viz: finely granulated tin, or rather tin in fine pow-

der, (formed by shaking melted tin in a joint of bamboo, or a wooden box,) this is mixed up in a vehicle of glue water, is burnished by an agate when dry, and is then covered with oil varnish: in this state it defies for a long time the sun and rain of a tropical climate.

American Locomotives.—On Monday, the 10th of August, several experiments were made on the Bromsgrove Lickey inclined plane, on the Birmingham and Gloucester Railway, with the *Philadelphia* locomotive engine, in the presence of the government commissioner, Sir Frederick Smith, and many other gentlemen, including Mr. Shelley of the Treasury, Mr. Amsink, Mr. Henry Woodington, and Mr. Burgess the secretary to the railway company.

The length of the Lickey incline is 2 miles, and the average slope is 1 in 37½. The steepest portion is 1 in 34, and the easiest 1 in 40. The *Philadelphia* engine was made by Mr. W. Norris, of Philadelphia. It has 12½ inch cylinders, a 20-inch stroke, and driving wheels of 4 feet in diameter. These wheels are at the hinder part of the engine, and at the fore part there are four bearing wheels of 2 feet 6 inches in diameter. The engine and tender, including the coke and water, weigh about 19 tons.

First experiment. The load in this experiment amounted to 47½ tons, contained in five carriages, exclusive of the weight of the engine and tender, which, as before stated, amounted to 19 tons. The engine started from the plane of the Bromsgrove station, which is 1 in 300, and after moving about 100 yards on this incline, it commenced the ascent of the steep plane of the Lickey. The distance of 2 miles and one-tenth was performed in 10 minutes, being at the rate of rather more than 12¼ miles per hour. In ascending the plane the engine was attached to the hinder part of the train, and four breaks were used for the purpose of retarding the speed. The descent was performed in precisely the same time as the ascent, and the load was 6½ tons more than that which ascended the plane—another carriage having been added to the train at the top of the plane.

Second experiment. On the second trip the load weighed 54 tons, in addition to the weight of the engine and tender. The ascent was on this occasion performed in 11½ minutes—being at abcut the rate of 11 miles an hour. In ascending the plane, on both occasions, the steam pressure was at about 60lbs., and the engine gradually increased her speed till she reached the summit, where, in consequence of the unfinished state of the work, it was necessary to stop the train. The great desideratum of ascending very steep inclines at a moderate rate of speed, by locomotive engines drawing heavy loads, would thus seem to be in a fair way of being obtained, but before a definitive judgment can be passed on this very important subject it will be necessary to make trials with this or similar engines in very wet and frosty weather, or during the fall of sleet in the winter. The most important point, however, to be attended to, is the safety of passengers in descending the plane. With careful breaksmen and a sufficient number of breaks, there does not appear to be any reason why this plane should not be worked with as much safety as other planes of less severe inclination; and in order to give entire confidence to the public, experiments should

be made to ascertain the smallest number of breaks that may suffice to keep the carriages under command, and this number should always be increased in practice. The plane here in question, has the advantage of being in a straight line.

Whatever may be the result, it is highly creditable to the engineer of the Birmingham and Gloucester railway to have suggested this experiment, and to the directors to have sanctioned it, for if it should prove to be entirely successful, a great step will have been made towards reducing the cost of railways by diminishing the extent of cuttings and embankments; and, on the other hand, if the application of the American engines to the Lickey incline be given up (which is to be hoped will not be found necessary,) and a stationary engine substituted, no extra expense will be thrown upon the company, as the *Philadelphia* can be used on other parts of the line. The engines chiefly in use between Cheltenham and Bromsgrove, are of American manufacture, and seem to answer admirably for this railway. The average speed between these two places, including stoppages, does not exceed 22 miles per hour, but the velocity on the ruling gradient of 1 in 300 is about 25 miles on the ascending, and 30 on the descending planes.

The rails are partly laid on transverse and partly on longitudinal sleepers, and although the carriages run very smoothly on both, the superior ease of traveling on the latter is very perceptible. London Surveyor, &c.

Development of Odors.—Every one is acquainted with the rotation which a piece of camphor undergoes in water, and the explanation of the fact which usually ascribes it to the disengagement of the odorant vapors which exhale from it. It is known also that the leaves of the *schinus molle* placed on water, forcibly retract when the surface of the water is covered by a layer of odoriferous oil. M. Morren has just observed a similar phenomenon produced by the volatile oil secreted by the down of the *passiflora fœtida.* When some of the down or hair is placed under water, a small drop of green oil detaches from it, and swims on the water. This drop expands, contracts, expands, contracts again, then seems to burst with force, but the fragments unite to expand again a moment after, and thus the action goes on for about ten minutes, after which the oil is by degrees concentrated, and becomes motionless. These facts may serve, perhaps, to point out a physical theory of odors. Jour. de Phar.

Canal Boats.—Mr. William Houston, of Johnston Castle, has invented a means of propelling boats, on canals, by the use of the Archimedean Screw, at the rate of twelve miles an hour. Boats for the Glasgow and Paisley Canal, are now in course of construction.

Greek Architecture.—The small upright ornaments called *ante-fixæ*, from their being fixed against the bottom tiles so as to stop the openings of the joints, exhibit one instance, among many, of the felicitous methods in which the imaginative and judicious Greek made service and decoration go hand in hand. With him, ornament was always expressive, signifying either a practical purpose or an appropriate feeling; rendering constructive necessaries graceful as beautifying appendages, satisfying the eye, by effecting a due balance or uniformity of exhibition;

or generating a certain sentiment in harmony with the object and general character of the design. That universal homage which enlightened nations have ever paid to the architecture of the Greeks, is simply the natural result of its palpable truth—a truth not only declared by those whose historical and critical education may qualify them to estimate it, but obvious even to others, who may be unprepared with *reasons* for their belief. The distinction between the learned and the unlearned commentator will be this—the one is acquainted with the *truth* of Greek beauty, the other is intuitively convinced that Greek beauty is *true*. The one knows the original of the portrait; the other is assured that it *is* a portrait. We know that such and such paintings, by Titian and Vandyke, had their originals in the truth of nature, though we may neither have seen nor heard of those originals.

He, however, who would rival the Greek temple, must imitate, not the *temple*, but the *Greek;* not the Parthenon, which was simply designed for purposes which no longer exist, but the architect, whose object was to render his work intelligible as an expositor of his country's religious and intellectual distinction. York Minster is, in *spirit* more like the Parthenon than any now-erected *fac-simile* of the latter could possibly be. Palace of Architecture.

Durability of Leather.—Visitors to the Hospital of St. Cross, near Winchester, are shown in the hall, two leather stoups, or black-jacks, for ale, which are, upon pretty good authority, stated to be three hundred years old. Perhaps a more striking proof could hardly be advanced that there really is, for durability, "*nothing like leather*."

New Fuel.—The Rev. Mr. Cobbold has invented a fuel composed of peat and the common refuse of gas-tar, which burns with a bright flame, little or no smoke, and gives out an intense heat. It has no smell whatever, and has been tried in a grate, in comparison with coal. According to this experiment, which was made by a chemist (with one-fourth less in weight of the fuel,) two quarts of water were evaporated in thirty-five minutes, leaving a good fire afterwards; while with Newcastle coal it took fifty-one minutes, leaving a low burnt-out fire. Mr. Cobbold says he can render this fuel at 7*s.* per ton.

Advantage of Studying Nature.—I have before hinted that the coloring of animals is an important part in their economy. I remember holding a conversation with a scientific friend, as remarkable for the originality of his genius as for his love of piscatorial pursuits, and the conversation turned upon what was the best dress to fish in. Perhaps you are aware that Izaak Walton says, that a fisherman must be a sad man dressed in a sober suit. My friend, however, said that if he were to dress for fishing, he would put on a sky-blue coat and white waistcoat; he would dress "sky fashion." Shortly after this conversation, while walking through a collection of aquatic birds, I was rather startled to find that they almost all wore blue coats and white waistcoats; almost all of them were dressed "sky fashion;" and if you look at the heron, you will see an illustration of this. Look at the sea gulls, and you will find blue coats and white waistcoats upon them. Is not this astonishing?

What could induce the little fish to come within the reach of the heron? Were he visible, depend upon it the fishes would go in all directions; but on account of his color, they are not able to perceive his presence. The color of birds will be found worth our attention. Colors, as I have said before, are invariably given for concealment. What, you will say, is the parrot colored for concealment? are those beautiful tropical birds colored for concealment? True, they are not colored for concealment, while they are in your cabinets, but put them in their native situations, and examine them there, and you will find that these brilliant colors are better defences than any more sober ones would be. Look at the heads of these creatures, and fancy them among the fruit trees of tropical regions, and tell me if this gaudy plumage is not the best possible defence they could have. If you want a better illustration of this, look at the grouse of the northern regions. The feathers of the ptarmigan grouse are brown—the color of the heather in which it lives; and the eye of the sportsman will pass over it. But let the ground be covered with snow, and its color would make it a conspicuous object. What is to be done? No sooner does the snow begin to fall, than the ptarmigan takes off its summer coat, and puts on its winter great coat, which is white instead of brown, and thus the grouse is equally secure in the winter as the summer. I wish I could direct the attention of this audience emphatically to a study of the colors of the animal creation. It is a subject which, in this country, and more especially in our manufacturing districts, is too little attended to. Where are all our important and valuable works in natural history produced? Not in England. When does the English press give birth to those works in which every tint of the humming bird, blazing and gorgeous as it is, is copied with the minutest accuracy? In France we have these works; but in England they are never purchased, and would never pay. And by whom are they there made to pay? The ornithologist? No: but those who make up patterns for dresses. The weavers and manufacturers know the importance of studying the colors that nature puts together; and you will find that the authors of these works look for support to that class who have sense enough to see, that to "gild refined gold and paint the lily," or "add purple to the violet," would be extravagant; and that the combination of colors in the animal world, like all other operations of nature, is perfect. Nothing can be added or taken away without diminishing the effect of the whole. They are content, therefore, to take lessons of nature in this particular, and we all acknowledge the success with which they manage this department of their manufactures. Lecture before the Royal Inst. Manchester.

New mode of Cleaning Chimneys.—I beg leave to call your attention to an invention of mine, intended to supersede the use of climbing boys, a model of which I have sent to the Polytechnic Institution. By this model there would be no necessity for having the flues of chimneys so wide that, in my humble opinion, the heat of the fire is not sufficient to rarify the air in them, so as to cause a proper draught, and therefore requiring the unsightly addition of chimney pots. The invention may be applied to any chimney, be it ever so small, or have ever so many angles. It may be thus described:—place across the top of the chimney, rather

on one side, a small round bar of iron or pulley, over which put an endless chain, or prepared rope, descending to the mouth of the chimney or flue, where it will pass round another small bar placed there. Then, to any part of the chain or rope, attach a small whalebone brush, which, being pulled up or down alternately, will effectually bring down all the soot. After use, the brush to be taken off, the chain or rope will remain in the chimneys, and be available at all times.

The Power of Machinery.—It is calculated that two hundred arms, with machines, now manufacture as much cotton as twenty millions of arms could manufacture, without machines, forty years ago; and that the cotton now manufactured in the course of one year in Great Britain would require, without machines, sixteen millions of workmen with single wheels. It is further calculated, that the quantity of manufactures of all sorts, at present produced by British workmen with the aid of machines, is so great that it would require, without the aid of machinery, the labor of four hundred millions of workmen.

Railway Traveling.—The facilities afforded by railways is well illustrated by the fact, that the distance between London and York is traversed in two hours less time than that between London and Lincoln, although York is seventy miles further from London than Lincoln is!

It would require twelve stage coaches, carrying fifteen passengers each, and one thousand two hundred horses, to take one hundred and eighty passengers two hundred and forty miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam engine will take that number, and go double the distance in the same time, and, consequently will do the work of two thousand four hundred horses!

Analogies of Nature and Art.—A writer upon this theme, in the London Surveyor, &c., speaks after the following beautiful and instructive manner: "The reduction in the substances of trees towards their tops—the tapering figure of all plants—the hollow cavity in bones—stalks of corn, feathers, &c., are not only so many means of insuring additional strength and stability, but, at the same time, the greatest effect with the least expenditure of material—for nature is a true economist, or in the words of a living writer, 'Creative power, infinite in its developement, is infinitely economized in its operations.' Hence the judicious imitation of this in the casting of columns and girders, also, the recent construction of the beautiful suspension bridge over the Avon, by Mr. Dredge, are but so many more instances of the invariable success attending Art when she follows in the footsteps of Nature.* By the way, can any thing illustrate so perfectly and beautifully the correct principles of the catenary or suspension bridge, with its system of tie and braces, as the web of the spider? When did science ever set about the performance of any work with more methodical precision, or

* From the comparison of a number of experiments, Mr. Hodgkinson was induced to adopt a certain form in the casting of iron beams, as being the strongest and least expensive. Now, curiously euough, it is observed that this particular principle is but the adaptation of what was already universal in all natural constructions.—*See Professor Mosely's Illustrations of Mechanics.*

upon truer geometrical principles? With what nice art and delicate adjustment is each separate fibre made to perform its proper individual function, and mutual relationship with the whole, and what strength, convenience, and beauty in the finished result! A careful study of this little workman's labors might yet teach us much to improve in the construction of our suspension bridges. Under any circumstance, we imagine that such would not be an indifferent school for the acquirement of the true principles upon which those works ought to be conducted.* The fable of the metamorphosis of Arachne, by Minerva, is not devoid of meaning; it but typifies the *wisdom* which first urged man to imitate the art of the spider. It is not, we believe, generally known that Watt derived from the formation of a lobster's tail the first hint of the flexible joint in his ingenious method for carrying pure water across the bed of the Clyde, thereby accomplishing easily, and at little cost, what otherwise would have implied a vast outlay of capital and labor. Again, from the mechanism of the human body how many ingenious modifications of machinery have not been effected! The elbow alone, with its simple and beautiful articulation and complication of movements, is a world of mechanical arrangements. It has been happily imitated by Mr. Collinge, in the form of a hinge; and the common contrivance known as the ball and socket joint must be familiar to every one; but the following anecdote, of all others, bears with peculiar force upon the subject—it was related to us by a gentleman well known as an engineer, and the talented inventor of many works of much practical merit connected with the useful arts:—Some years back, having devised a method for cutting out by machinery the most complicated patterns and designs for inlaying floors and other purposes, there happened to be one consisting of a peculiar spiral, which all his ingenuity was unable to compass. After several trials, all equally unsuccessful, with every variety and combination of tools, he was at last induced to give up the attempt in despair; but having occasion, shortly after, to examine the state of some timbers in a wharf on the river, he observed that the incursions of a certain small and destructive worm had gradually worked a groove into the wood, bearing a striking resemblance to the peculiar spiral which had so long baffled all his efforts to imitate. A closer examination, to his great delight, confirmed the fact, and the mandibles of the animal suggested the construction and form of a tool which fully realized his most sanguine expectations; and so, the weak and despised worm, working in its quiet obscurity, became the humble instrument of accomplishing that, which all the resources of art and money had been unable to effect."

Draining the Haarlem Lake.—M. Dietz, the Dutch engineer, has invented a machine, which it is supposed will be adopted for this purpose, and by means of which he calculates that 100,000 cubic ells of water may be drained off daily. He estimates the body of water in the Haarlem Sea at 770,000,000 cubic feet, to empty which it would require ten

*** The use of the diving bell is not confined to man. There is a species of spider (*argyroneta aquatica*) which is amphibious, whose subaqueous habitation is constructed upon principles strictly analogous.**

of his machines of 30-horse power each: the quantity drained off by them daily would be about 1,000,000 cubic feet, for a period of 800 days. The estimated expenditure of this work is as follows:—

Ten machines, at 30,000 florins each	300,000
Coals, &c., 500 florins per diem, for 800 days...........	400,000
Sixty workmen, at $1\frac{1}{2}$*f.* each, per diem, for 800 days....	72,000
Superintendence, plans, &c.	25,000
	797,000
	About £66,416

Steam Boilers.—At the sitting of the Society for the Encouragement of National Industry, on the report of M. Séguier, a gold medal was decreed to M. Chaussenot, for an apparatus to render the explosion of steam boilers impossible. According to the report, his invention is perfect, both as regards its improvements on the safety-valve, and an ingenious contrivance to give notice to the crew and passengers of impending danger. Even the contingency of wilful mischief is provided against; as in the event of all the warnings of his machinery failing, or being disregarded, the steam flows back upon the furnace, extinguishes the fire, and destroys all possibility of an explosion.

Floating Breakwaters.—An enterprising individual, Capt. Tayler, of H. M. S. San Josef, has brought forward a plan for forming a breakwater, by a series of moored floating frames of timber immersed to a depth of nine feet, and which he confidently asserts will destroy the violent action of the sea, and produce still water behind it, even during the severest gales. The plan of using rafts, or other floating constructions for breakwaters, is not new, and indeed has been practiced by sailors from time immemorial; when a vessel is unable to bear the buffeting of a gale, or a boat, or other small craft, is in danger of swamping by the violence of the sea, it is a common plan to lash as many spars together as they have, and cast them overboard, to which they make fast the bow of the vessel with a bridle, and providing there is plenty of drifting room, a vessel so circumstanced may ride in safety; for the waves first breaking over the raft, are dismembered, and lose their power before reaching the vessel. That floating breakwaters will at no distant period be adopted, where, either from want of large funds, or the hazardous nature of permanent works, they may be applicable, we have not the least doubt; and as the cost is so very trifling, and in the event of non-success, the loss which will be incurred—the timber being as valuable as in the first instance—so very small, that we may confidently look forward to the establishment of harbors in situations and localities where a permanent or fixed work would never be thought of.

The force acting on a frame, or section of breakwater, according to Captain Tayler, is as follows: each section being 60 feet long, 27 feet deep, and 25 feet wide, with the part below the line of floatation 9 feet, and consequently the number of superficial feet exposed to the action of the sea, 540. A lateral pressure of 144 lbs. on every foot is allowed for the force of the sea; but as a great deal of water will be forced

through the breakwater, 47 lbs. are deducted from the 144 lbs., leaving the actual force 97 lbs. on the square foot; then, 540 feet multiplied by 97 lbs. gives 52,380 lbs. of water, equaling the heaviest striking force of the sea. Taking the power of the wind at 18 lbs. to a superficial foot;—540 feet multiplied by 18 lbs. gives 9,720 lbs. for the force of the wind; allowing 5,000 lbs. for the power of the tide; then 52,380, +9,720+5,000, are 67,100 lbs. for the whole of the acting force.

The portion immerged is 18 feet, by 25 feet wide, so that the sea has to push the floating body before it, which offers nearly thrice the resistance to the momentum of its velocity upon the 9 feet below the line of floatation.

The sea has also to raise the mooring chains on which there never can be a strain more than equal to their strength, and consequently they cannot be broken. Although an allowance is made for the wind, it cannot act when a sea is breaking over the breakwater.

The following is a comparison of the force of the wind and sea upon lighthouse vessels, with the same on the breakwater. These vessels are in the Gulf Stream, off the Goodwin Sands, Portsmouth, Dublin, and on a shoal in the North Sea.

A vessel of 25 feet beam, and 12 feet high, exposes a bow of 300 superficial feet, and the same number of feet being allowed for the hull, makes altogether 600 feet. 600 feet multiplied by 36 lbs. allowed for the pressure of the wind upon every foot, gives 21,600 lbs. power of wind acting upon the vessel. Admitting 144 lbs. of water (the amount acting on the breakwater,) to act upon the vessel's bows of 300 feet; then multiplying 144 lbs. by 300 feet, you have 43,200 lbs., and adding 21,600 lbs. pressure of the wind, and half that power, or 10,300 lbs. for the tide, the whole force is equal to 75,600 lbs.

In this calculation not one-fourth of the wind's power upon the vessel in a heavy gale is allowed, and it should be remembered that the breaking of the sea does not relieve a vessel from the action of the wind. Thus it is shown that such lighthouse vessels do not break from their moorings. The construction of the floating breakwater relieves it moreover of much of the power of the sea.

[There appears to be some ambiguity in the reasoning of this paper, and an inaccuracy in the calculation of the wind's force on a floating lighthouse, which is taken at 36 lbs. on the square foot; whereas, on the floating breakwater, it is taken only at 18 lbs. In an extremely violent hurricane the wind acts with a power nearly equal to 50 lbs. on the square foot, which is the proper force to be provided against in every instance.—*Ed. Surveyor, &c.*]

Slate Pavements.—Experiments have been made to ascertain the applicability of slate to other uses than the covering of houses. The result has been the discovery that, as a material for paving the floors of warehouses, cellars, wash-houses, barns, &c., where great strength and durability are required, it is far superior to any known material. In the extensive warehouses of the London docks it has been used on a large scale. The stones forming several of the old floors having become broken and decayed, have been replaced with slate two inches thick; and one wooden floor, which otherwise must have been relaid, has been

cased with slate one inch thick, and the whole have been found to answer very completely. The trucks used in removing the heaviest weights are worked with fewer hands. The slabs being sawn, and cemented closely together as they are laid down, unite so perfectly that the molasses, oil, turpentine, or other commodity which is spilt upon the floor, is all saved; and as slate is non-absorbent, is so easily cleaned, and dries so soon, that a floor upon which sugar in a moist condition has been placed, may be ready for the reception of the most delicate goods in a few hours. Waggons or carts, containing four or five tons of goods pass over truckways of two inch slate without making the slightest impression. In no one instance has it been found that a floor made of sawn slate has given way; in point of durability, therefore, it may be considered superior to every other commodity applied to such uses.

DESCRIPTION OF AMERICAN PATENTS

Granted from Nov. 10th to Dec. 1st, 1840.

Improvement in the Machine for Cutting Nails, Brads, &c. By Geo. D. Strong and Jonathan Dodge, assignees of Walter Hunt, New-York City. Nov. 13th.

Claim.—I claim the plan of forming the cutters for cutting nails, brads, &c., from staves, or longitudinal sections of metal zones or thimbles, in the form or forms above specified, whether the same are first made, or turned in entire pieces, and afterwards cut or sawed into sections, or whether said sections are fitted up separate, or made of cast steel or other metal.

I also claim, in connection with said above described cutters, or those of any other form, having similar shaped cutting surfaces, or edges, the mode of arranging the same, in such manner as to operate upon the same principle of motion, (that is to say) arranged in two opposite pairs, fitted in levers, or other fastenings, by the vibrating motion of which levers, two opposite cutters, one from each pair, is made to approximate and pass each other, operating as cylindrical shears, in cutting off one nail, and as these cutters recede, the other pair operate in a similar manner in cutting the next nail, alternately.

And I further claim the combination and general arrangement of the head, levers, cutters, and spring guage constructed and arranged as above set forth and described, without reference to the particular form of the cutting edges of the cutters, for the purpose of cutting nails, brads, tacks, &c., without regard to the particular form or shape of the same.

Improvement in the Door Spring. By William W. Smith and Benjamin Mulliken, Jr., New-York City. Nov. 13th.

Claim.—What we claim, and desire to secure by letters patent, as our invention, is the combination of the spring, crank and levers, acting upon the arm attached to the door or gate, in the manner and for the purpose specified.

Improvement in the Machine for Manufacturing Balls or Shot. By LEVI MAGERS, Baltimore, Md. Nov. 13th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the combination of the furnace and kettle with th moulds as herein described, and also the combination and arrangement with the carriage in the manner described.

Improvement in the Windlass Bedstead. By THOMAS LAMB, Washington City, D. C. Nov. 13th.

CLAIM.—What I claim therein is, the combination of the groove on the tenon in connection with the pin in the mortise, with the windlass, to obtain 1st, the "new effect" of keeping the tenon from being displaced laterally until the windlass can be brought to act; and 2nd, to keep the rail and post close while the lever is acting, and prevent their separation by the strain of turning the lever, as the windlass has no power to draw its tenon laterally, and the groove and pin and tenon have no power, on the other hand, to keep the rail tight, when drawn tight against the post, without the windlass; and 3rd, also to obtain the additional result of keeping the pall of the windlass up to and directly over the ratchet wheel, so that the pall shall certainly act, and thus the combination of the parts acting together and mutually aiding the action of each other.

Machine for Sawing Paving Blocks of Wood. By AMAZIAH NASH, Calais, Washington Co. Me. Nov. 13th.

CLAIM.—The invention claimed and desired to be secured by letters patent, consists in the combination and arrangement of the longitudinally moving carriage, transversely moving slide, (with its hanging frame and gearing for holding the block of wood to be sawed, and advancing or receding the same to or from the saw, and turning it horizontally in order to saw it into a polygon or other figure,) and the notched wheel and dog with the sliding frame and saw, as described; also in combination with the sliding frame and saw, the frame, shaft, notched wheel, latch, and lever, represented in fig. 2, for adjusting and holding the block to be sawed, used instead of the hanging frame and gearing before described.

Improvement in Churns. By CONSTANT WEBB, Wallingford, Conn. Nov. 26th.

CLAIM.—What I claim as my invention and desire to secure by letters patent, is the reel and manner in which the agitating wing-boards are arranged upon the arms of the cross, and thus form the peculiar reel of the churn, as set forth in the specification, viz. by attaching to each arm of the cross on the arbor or axle, an agitating wing, made fast to the arm at one end, and passing the line of the axle obliquely to the left, at an angle of about 30 degrees; each wing being about 3 inches broad, at the end by which it is made fast to the arm of the cross, and gradually reduced to about half that width at the other end, and of such length and so curved as to approach, but not to touch the sides or bottom of the churn, as more particularly described in my specification as above.

Improvement in Musical Instruments, entitled the Vocal Organ. By JOHN W. CAMPBELL, Attica, Indiana. Nov. 26th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the construction of the vocal apparatus herein described, consisting of the vocal box with its vibrating tongues as set forth, and the mouth piece and fauces attached to the same.

I also claim the placing of the foregoing vocal apparatus, or such number of them as may be necessary to produce the required notes, in a box constructed in the manner herein described.

The said vocal pieces being arranged beside each other, and governed by stops operated by keys for producing the tone in the manner herein set forth.

Improvement in Cooking Stoves. By DAVID H. HILLIARD, Cornish, N.H. Nov. 26th.

CLAIM.—What I claim as my invention therein, and desire to secure by letters patent, is the manner in which I have constructed the bottom of my fire chamber, with grated openings through the anterior part thereof, and combined therewith an ash-pit drawer, having a flat plate in front of sufficient width to cover these openings, and an aperture in the rear, for the purpose of admitting air, the whole operating in the manner set forth. And in combination therewith, I claim the strips of metal, *b b*, and *c c*, arranged and operating as described, for the purpose of closing the flue space at the back of the fire chamber, when required.

Improvement in Spark Extinguishers. By DAVID RITTER, New Haven, Conn. Nov. 26th.

CLAIM.—I do not claim as my invention the conductor for carrying off the sparks from the chimney of the locomotive, nor the openings for the draft on the top or in front of it, which openings may be used or not as occasion may require. But I do claim as my invention the combination of the cistern, or reservoir of water, with the conductor for carrying the sparks and dust from the chimney and depositing them perpendicularly downwards in the reservoir, and thereby extinguishing the sparks and absorbing the dust, permitting the smoke only to escape from the reservoir, all in the manner set forth in the above specification.

Improvements in Rotary Steam Engines. By JACOB C. ROBIE, Binghamton, N.Y. Nov. 26th.

CLAIM.—What I claim therein, and desire to secure by letters patent, is the manner of packing the sides of the revolving drum, by means of the annular plates *J′J′*, embracing its edges, and otherwise constructed and operating as set forth.

I also claim the forming of recesses within the heads of the stationary drum, to receive and sustain the projecting edges of the valves, as described.

The other parts of the within described machine I do not claim, this being, in general, substantially the same as have been before known and used.

Improvements in Machinery for Straining and Preserving Clothes-Lines. By Edwin Allyn and C. B. Hildreth, Boston, Mass. Nov. 26th.

Claim.—We shall claim as our invention, the combination of a spool or bobbin, having a windlass, ratchet wheel and catch, with a casing having a slide in front, and also the single and double snatch-blocks, the whole being constructed, arranged and operating substantially as herein above specified, and for the purposes of straining and preserving clothes lines.

Improved method of removing Straw, and separating the Grain, in Threshing Machines. By John Criswell, Cecil, Pa. Nov. 26th.

Claim.—What I claim as my invention, and desire to secure by letters patent, consists in forming the rack marked *K*, as an inclined plane, and carrying the straw over it by a belt of rakes passing over rollers, by which rakes the straw is removed to a convenient place, marked *L*, and the grain by passing through the open rack is completely separated from the straw, and is also collected and deposited in a convenient place at *W*.

Improvements in the construction of Ships Cabooses and other Cooking Stoves. By Loftis Wood, New-York. Nov. 26th.

Claim.—I do hereby declare that I do not claim the constructing a grate with hollow bars as of my invention, this having been previously done, but not for the purpose, or in the combination, devised by me; nor do I claim the mere admitting of heated air into an oven, this, also, having been done before; but, so far as I am informed, the heated air so admitted has been such as has passed through the burning fuel, whilst that admitted by me is the pure, undecomposed atmospheric air; nor has air ever been so admitted under the combination and arrangement of the respective parts of the apparatus, as herein made known; but what I do claim, therefore, as constituting my invention, and desire to secure by letters patent, is the manner in which I construct and combine the grate bars and the oven, as herein described; that is to say, the forming of my grate with hollow bars, the openings through which lead into the flue space under the oven, for the purpose of heating atmospheric air and conducting it into said flue space; and, in combination therewith, I claim the openings through the bottom and back oven plates, for allowing the air so heated to pass into and through the oven, its passage being governed by a shutter, or damper, as described.

Improvement in the construction of Portable Furnaces for Heating the Water in Bathing Tubs. By Randolph Densmore, Hopewell, N. Y. Nov. 26th.

Claim.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the giving to the body of the furnace for the heating of baths, a cylindrical form, and placing the tube, or tubes, channel, or channels, through which air is supplied to the fire, within said body, in the manner and for the purpose herein set forth. And it is to be understood that although I have mentioned a cylindrical form only, as given to the furnace body, I do not intend thereby to limit

myself to this particular shape, as the body may he made oval, or polygonal, or be otherwise varied in form, whilst the instrument will remain substantially the same in all its essential characteristics.

Improvement in the Manufacture of Splints or Sticks for friction Matches and other articles. By NORMAN T. WINANS and THADDEUS HYATT, New-York. Nov. 26th.

CLAIM.—Having thus described the nature of our invention, and shown the manner in which we carry the same into operation, what we claim therein, and desire to secure by letters patent, is the manufacturing of splints, or sticks for matches of wood condensed by mechanical pressure between rollers, or dies, as herein set forth.

Improvement in the mode of regulating the Waste Steam in Locomotive Steam Engines. By ROSS WINANS, Baltimore, Md. Nov. 26th.

CLAIM.—I do claim as my invention, desiring to secure the same by letters patent, the plan of increasing or diminishing the force with which the steam from the cylinders enters the chimney, at the pleasure of the engine-man while the engine is in use or motion, by enlarging or contracting the orifices of the escape-pipes—increasing or diminishing thereby, at pleasure, the draught of the chimney, in the manner above set forth; not intending by this claim to limit myself to the precise arrangement of the respective parts as herein described, but to vary the same as I may think proper, whilst I attain the same end by means substantially the same.

Improvement in apparatus for sinking Wells in alluvial soils. By EBENEZER RICE, Salina, N. Y. Nov. 26th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the method of sinking wells in alluvial soils, and marshy grounds, by means of wooden tubing formed in lengths, connected together by metal bands or hoops sunk in the ends, together with a metal band on the outside, and provided with a metal tube at the bottom, and also the follower on the top constructed and applied in the manner and for the purposes described in the above specification.

Improvement in the " Cut-off" Valves of Steam Engines. By WM. A. LIGHTHALL, Albany, N. Y. Nov. 26th.

CLAIM.—I claim as my invention, or improvement, the combination of two valves working on one stem, constructed as herein before described, to wit—with rims or collars of sufficient depth to allow the requisite degree of motion while in their seats, and yet continuing to keep the openings closed, and with lugs, or guides, which prevent the valves from being displaced, and at the same time allow the steam to pass freely through the spaces between them.

Improvement in the Machine for Skeining Silk. By GEORGE HERITAGE, Chestertown, Md. Nov. 26th.

CLAIM.—What I claim as my invention, and which I desire to secure

by letters patent, is the before described mode of skeining the silk by the arrangement of the moveable and stationary bars and rows of pins in combination with the reel, as described.

Improvement in the manner of forming oblique catches, protuberances, and dove-tailed fastenings, on plates and other pieces of cast iron, &c. By JORDAN L. MOTT, New-York. Dec. 1st.

CLAIM.—What I claim, therefore, as constituting my invention, and desire to secure by letters patent, is the manner herein described of forming such catches and projection, by means of a punch, or piece, properly formed for the purpose, there being corresponding openings through the pattern, or through a plate adapted thereto, as herein fully set forth.

Improvement in the mode of constructing a Combined Caldron and Furnace for the use of Agriculturists and others. By JORDAN L. MOTT, New-York, Dec. 1st.

CLAIM.—What I claim in the above described apparatus as of my invention, and which I desire to secure by letters patent, is the combining of the portable furnace with the caldron, or boiler, by elevating the sides of said furnace, and connecting therewith the sectional side pieces which constitute a flue surrounding the caldron, or boiler; the whole being constructed, combined, and operating substantially in the manner, and for the purpose herein fully set forth.

Improvement in the Lock and Key. By WILLIAM MORRETT WILLIAMS, Mile End, Old Town, Middlesex Co., Great Britain. Dec. 1st.

CLAIM.—What I claim therein, and desire to secure by letters patent, is the manner in which I have combined the rack on the bolt, the rack box, the sliding pieces *g*, and the respective springs, lever, and other parts, so as to be acted upon by means of the key, or instrument for opening or closing the same; the whole being constructed and operating substantially as herein set forth, in the application thereof to a padlock. I also claim the application of the same principle, or general manner of construction, as herein exemplified, in its application to door locks, and to the securing of cocks, or taps, for the drawing of liquids, and also to other objects and purposes to which it can be applied, whilst the principle of construction and manner of operation remain substantially the same, producing a like effect by analogous means.

Improvement in the mode of Heating Buildings by means of an apparatus consisting of Tubes for the generation of hot Water, arranged in an air chamber, adapted to the same. By GEORGE M. DEXTER, Boston, Mass. Dec. 1st.

CLAIM.—What I claim as constituting my invention and improvement, is the heating of air in a chamber constructed for that purpose, within which chamber there is a system of tubes, which tubes are heated by causing water to circulate through them in manner set forth, said water being at a temperature below that of boiling, and being supplied

by a heating vessel arranged and operating substantially in the manner described, and the air so heated being conveyed from the said air heating chamber through large trunks, or other openings, into the apartments to be warmed, as herein fully made known.

Improvement in Sleds for the Transportation of Ice in Blocks. By NATHANIEL J. WYETH, Cambridge, Mass. Dec. 1st.

CLAIM.—I claim as my invention, beveling the top surfaces of runners of an ice sled, substantially in the manner and for the purpose herein above described.

Improvement in the Machine for Cutting Ice. By NATHANIEL J. WYETH, Cambridge, Mass. Dec. 1st.

CLAIM.—I shall claim as my invention, forming the chisels of ice cutters of the curved shape in front and rear, as herein above specified, and likewise grooving the front, or curved cutting faces of the chisels, and constructing the same wider than the rear, or with lateral cutting edges, *gg*, for the purpose of effectually removing chips of ice or other extraneous matters, from the sides of the grooves, the whole being constructed and operating substantially as herein above described.

Improvements in Machinery for raising blocks of Ice from the water and depositing the same on to Sleds. By NATHANIEL J. WYETH, Cambridge, Mass. Dec. 1st.

CLAIM.—I shall claim in the same, raising blocks of ice from the water and depositing the same on a sled by means of *the apparatus denominated the gig*, in combination with a railway, the whole being constructed, arranged and operating together substantially in the manner and on the principles herein above described.

Improvements in Machinery for reducing blocks of Ice to a uniform thickness, and cutting parallel ridges on the upper surface of the same. By NATHANIEL J. WYETH, Cambridge, Mass. Dec. 1st.

CLAIM.—I shall claim in the same, forming ridges on the surface of the blocks of ice, and reducing the remainder of the blocks to a uniform thickness, by means of the shares and chisels, and a forcing carriage in combination with a railway under the same, the whole being arranged and operating together substantially in the manner and for the purposes herein above mentioned and described.

LIST OF ENGLISH PATENTS

Granted between the 26th of Sept. and the 22d October, 1840.

Frederic Payne Mackelcan, of Birmingham, for certain improved thrashing machinery, a portion of which may be used as a means of transmitting power to other machinery. October 1; six months.

Thomas Joyce, of Manchester, ironmonger, for a certain article which forms or may be used as a handsome knob for parlor and other doors, bell pulls, and curtain pins, and is also capable of being used for a variety of useful and ornamental purposes in the interior of dwelling houses and other places. October 1; six months.

William Henry Fox Talbot, of Lacock Abbey, Wilts, esquire, for improvements in producing or obtaining motive power. October 1; six months.

William Horsfall, of Manchester, card maker, for an improvement or improvements in cards for carding cotton, wool, silk, flax, and other fibrous substances. October 1; six months.

James Stirling, of Dundee, engineer, and Robert Stirling, of Galsten, Ayrshire, doctor in divinity, for certain improvements in air-engines. October 1; six months.

George Ritchie, of Gracechurch-street, and Edward Bowra, of the same place, manufacturers, for improvements in the manufacture of boas, muffs, cuffs, flounces, and tippets. October 1; six months.

James Fitt, sen. of Wilmer Gardens, Hoxton Old Town, manufacturer, for a novel construction of machinery for communicating mechanical power. October 7; six months.

John Davies, of Manchester, civil engineer, for certain improvements in machinery or apparatus for weaving, being a communication. October 7; six months.

Thomas Spencer, of Liverpool, carver and gilder, and John Wilson, of the same place, lecturer on chemistry, for certain improvements in the process of engraving on metals by means of voltaic electricity. October 7; six months.

Thomas Wood, the younger, of Wandsworth Road, Clapham, gentleman, for improvements in paving streets, roads, bridges, squares, paths, and such like ways. October 7; six months.

Charles Payne, of South Lambeth, Surrey, gentleman, for improvements in salting animal matters. October 13; six months.

Robert Pettit, of Woodhouse-place, Stepney green, gentleman, for improvements in railroads and in the carriages and wheels employed thereon. October 15; six months.

Henry George Francis, Earl of Ducie; Richard Clyburn, of Uley, engineer; and Edwin Budding, of Densley, engineer, for certain improvements in machinery for cutting vegetable and other substances. October 15; six months.

William Newton, of Chancery-lane, civil engineer, for an invention of certain improvements in engines to be worked by air or other gases, being a communication. October 15; six months.

James Hancock, of Sidney-square, Mile-end, civil engineer, for an improved method of raising water and other fluids. October 15; six months.

Henry Pinkus, of Panton-square, esquire, for an improved method of combining and applying materials applicable to the formation or construction of roads or ways. October 15; six months.

Charles Parker, of Darlington, flax-spinner, for improvements in looms for weaving linen and other fabrics to be worked by hand, steam, water, or any other motive power. October 22; six months.

Richard Edmunds, of Banbury, Oxford, gentleman, for certain improvements in machines or apparatus for preparing and drilling land, and for depositing seeds or manure therein. October 22; six months.

Thomas Clark, of Wolverhampton, ironfounder, for certain improvements in the construction of locks, latches, and such like fastenings applicable for securing doors, gates, windows, shutters, and such like purposes, being a communication. October 22; six months.

Gabriel Riddle, of Paternoster-row, stationer, and Thomas Piper, of Bishopgate-street, builder, for improvements on wheels for carriages. October 22; for the term of seven years, being an extension of the original letters patent granted to Theodore Jones, of Coleman-street, accountant.

List of Patents granted for Scotland from 22d August to 22d October.

George Saunders, Hooknorton, Oxford, clerk, and James Wilmot, of the same place, farmer, for improvements in machinery for dibbling, or setting wheat and other grain. Sealed, August 25, 1840.

Charles Wye Williams, of Liverpool, Lancaster, gentleman, for improvements in the means of generating heat, principally applicable to the production of steam and the prevention of smoke. August 28.

Thomas Gadd Matthews, of Bristol, merchant, and Robert Leonard, of the same place, merchant, for certain improvements in the machinery or apparatus for sawing, rasping, or dividing woods, or tanner's bark. August 31.

Miles Berry, of 66 Chancery lane, Middlesex, being a communication from abroad,

for certain improvements in the strengthening and preserving ligneous and vegetable substances. September 1.

Peter Fairbairn, of Leeds, York, engineer, being a communication from abroad, for certain improvements in machinery or apparatus for heckling, combing, preparing, or dressing hemp, flax, and other textile or fibrous materials. September 7.

Thomas Milner, of Liverpool, Lancaster, for certain improvements in boxes, safes, or other depositories for the protection of papers or other materials from fire. September 8.

John Johnston, of Glasgow, Lanark, North Britain, gentleman, for a new method (by means of machinery) of ascertaining the velocity of, or the space passed through, by ships, vessels, carriages, and other means of locomotion, part of which is also applicable to the measurement of time. September 14.

Edwin Travis, of Shaw Mills, near Oldham, Lancaster, cotton spinner, for certain improvements in the machinery or apparatus for preparing cotton and other fibrous materials. September 15.

Henry Curzon, of Kidderminster, Worcester, machinist, for improvements in steam-engines. September 16.

George Gwynne, of Portland-terrace, Regent's-park, Middlesex, gentleman, for improvements in the manufacture of candles, and operating upon oils and fats. September 16.

Henry Waterton, of Fulmer-place, Gerard's-cross, Buckingham, esquire, for certain improvements in the manufacture of sal-ammoniac. September 16.

John Gibson and Thomas Muir, both of Glasgow, Scotland, silk manufacturers, for improvements in cleaning silk and other fibrous substances. September 17.

James Stirling, of Dundee, engineer, and Robert Stirling, clerk, D.D. of Gelston, Ayrshire, for certain improvements in air-engines. September 17.

James Harvey, of Bazing Place, Waterloo Road, Surrey, gentleman, for improvements in extracting sulphur from pyrites, and other substances containing the same. September 21.

Gerard Ralston, of Tokenhouse Yard, London, merchant, being a communication from abroad, for improvements in rolling puddle balls, and other masses of iron. September 22.

John Lambert, of No. 12 Coventry-street, in the parish of St. James, Westminster, gentleman, for certain improvements in the manufacture of soap. (A communication.) September 24.

James Buchanan, merchant, of Glasgow, for certain improvements in the machinery applicable to the preparing, twisting and spinning, and also in the mode of preparing, twisting and spinning of hemp, flax and other fibrous substances, and certain improvements in the mode of applying tar, or other preservative to rope and other yarns. September 24.

Alexander Francis Campbell, of Great Plumstead, Norfolk, esquire, and Charles White, of Norwich, mechanic, for improvements in ploughs, and certain other agricultural improvements. September 29.

Amand de Plangue, of Lisle, in the kingdom of France, but now residing at 126 Regent-street, Middlesex, gentleman, for improvements in looms for weaving. (A communication.) September 29.

George Delianson Clark, of the Strand, Middlesex, gentleman, for improvements in coke ovens. (A communication.) October 5.

Richard Beard, of Egremont Place, New Road, Middlesex, gentleman, for improvements in printing calicoes and other fabrics. (A communication.) October 7.

Robert Beart, of Godmanchester, Huntingdon, miller, for improvements in apparatus for filtering fluids. October 14.

Thomas Farmer, of Gunnersbury House, near Acton, Middlesex, esquire, for improvements in treating pyrites to obtain sulphur, sulphurous acid, and other products. October 14.

List of Irish Patents, granted for October, 1840.

H. C. Rouquette, for a new pigment.

John Hawley, for improvements in pianos and harps.

W. Stone, for improvements in the manufacture of wine.

F. Vouillon, for improvements in the manufacture of ornamental woven fabrics.

M. Poole, for improvements in looms for weaving.

J. Lambert, for certain improvements in the manufacture of soap.

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